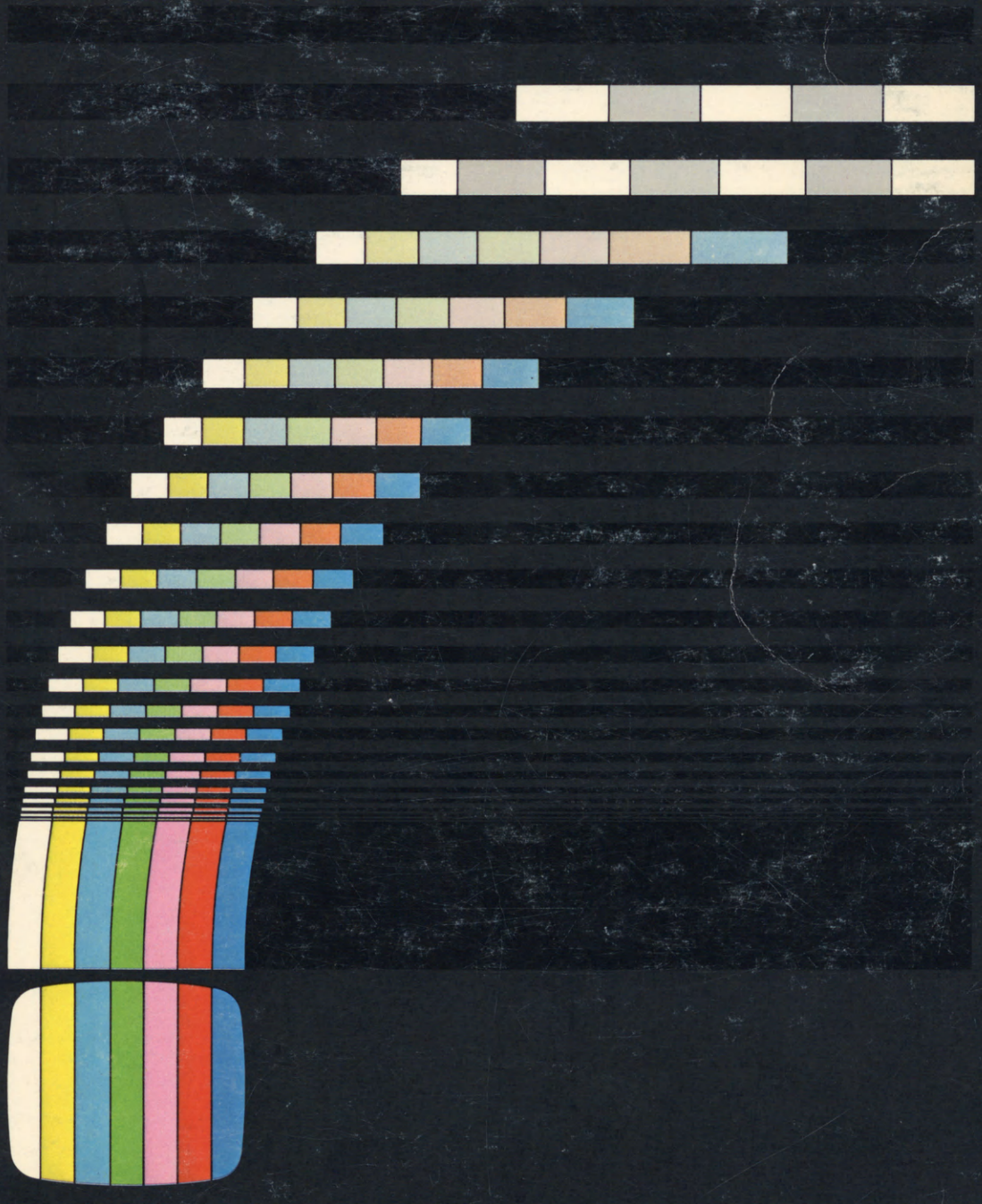
Tektronix

Television PRODUCTS



The Tektronix Television Products Catalog displays the products you need to measure, correct, and display the television signal. The catalog offers a broad selection of instruments for use at video baseband frequencies. The growing number of digital products and products used at radio frequencies demonstrates the Tektronix commitment to keeping pace with the needs of the video industry.

1

FOR YOUR SYSTEM, FOR YOUR COLOR STANDARD

No matter where you operate in the world today, Tektronix offers television products for you, including NTSC, SECAM, PAL, and PAL-M instruments. Here's a guide to help you find the products that interest you. The complete type number index is on the inside back cover.

WAVEFORM MONITORS

	Page
1480 Series. PAL, PAL-M, NTSC, SECAM	4
528. PAL, PAL-M, NTSC, SECAM	8

VECTORSCOPES

520A Series. PAL, PAL-M, NTSC	10
1420 Series. PAL, PAL-M, NTSC	13

PICTURE MONITORS

650 HR Series. PAL, NTSC	14
653 HR/656 HR. SECAM	17
670A Series. PAL, NTSC, NTSC + RGB	19

GENERATORS

1410 Series. PAL, PAL-M, NTSC	23
145-M. PAL-M	42
143. SECAM	40
1470 Series. NTSC	37
147A — 149A. NTSC	45
148. PAL	50
148-M. PAL-M	54
1441. NTSC	56
1461. PAL	56
1430. PAL, PAL-M, NTSC, SECAM	58

RADIO FREQUENCY PRODUCTS

	Page
1450 Demodulators and Television Down Converters. VHF and UHF for Systems M, B/G	59
1405 Sideband Adapter and Spectrum Analyzers	65

ANALYZERS/CORRECTORS

ANSWER and Peripherals. NTSC	67
1440. NTSC	72
1460. PAL	72

DIGITAL CONVERTERS

ADC 820	77
DAC 850	78

GENERAL PURPOSE PRODUCTS FOR TV

Oscilloscopes	79, 80, 81, 82
TM 500 Test and Measurement Instruments	82
J-16 TV Digital Photometer/Radiometer	87
Cameras for Oscilloscopes	88
Logic Analyzers	83
Display Monitors	85

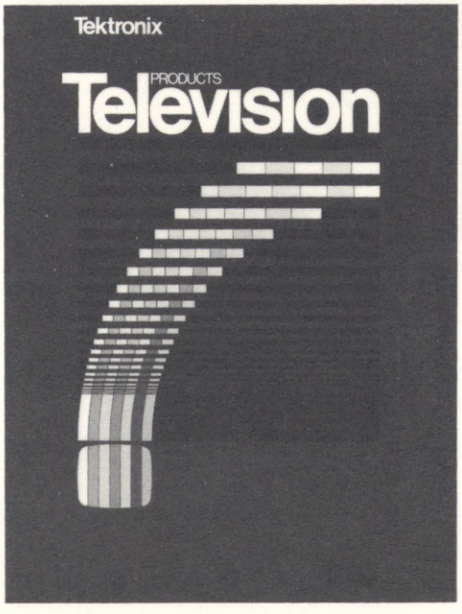
ACCESSORIES 90, 91, 92

GENERAL TERMS AND WARRANTY 96

TYPE NUMBER INDEX Inside back cover

THE COVER

A high quality picture on your viewer's television screen is what we are all working for. Tektronix' state-of-the-art digital products help you meet that goal — with new test signals, improved test signal stability and accuracy, automatic measurement capability, and highly accurate analog-to-digital and digital-to-analog conversion. And while you're putting today's digital products to work for you, we're designing tomorrow's.



Copyright © 1980, Tektronix, Inc. All rights reserved.

OVERVIEW OF INSTRUMENT CATEGORIES

Here's the Big Picture of Tektronix Television Products Section by Section

WAVEFORM MONITORS

To examine video waveforms with precision, you need a waveform monitor — an oscilloscope with special features and performance characteristics. The time base and synchronizing facilities of Tektronix Waveform Monitors provide accurate and stable line, field, and VITS line displays of the video signal. Tektronix Waveform Monitors also feature carefully controlled vertical amplifier characteristics and a versatile selection of responses. They provide precision amplitude measurements of the video signal and its chrominance, luminance, and synchronizing components.

VECTORSCOPES

Vectorscopes are oscilloscopes especially designed for examing the chrominance signal. They commonly display a polar plot of chrominance phase and amplitude. With Tektronix, you can choose from three kinds of vector display: (1) a full-featured vectorscope to use where you need resolution of small values of phase and amplitude (520A Series); (2) a compact, simple unit ideal for a dedicated installation in a CCU, VTR or similar system (1420 Series); and (3) a simple X-Y display (602 or 604A) driven by R-Y, B-Y drives from a Tektronix Picture Monitor.

PICTURE MONITORS

Consistent, high quality color reproduction is a critical requirement for picture monitors in production and engineering operations. Tektronix Color Picture Monitors are designed specifically to meet this requirement. You can use them to examine the entire video signal, including the details of the vertical and horizontal intervals. Our unique Blue Only display is especially designed to help you optimize videotape recorder performance. All Tektronix Monitors, including SECAM systems, give you the capability for making vector displays on X-Y oscilloscopes.

GENERATORS

Tektronix Television Signal Generators provide the high quality signals required to accurately time, test, evaluate, and adjust video equipment. They're available for all broadcast color standards: PAL, PAL-M, NTSC, and SECAM. For help in choosing the generator for you needs, refer to the Signal Generator Selection Chart on p. 22.

RADIO FREQUENCY PRODUCTS

Radio frequency testing has often been uncertain because of the inherent inaccuracies of test equipment. Until recently, the quality of radio frequency measurements had not reached levels achieved in video baseband operations. But now, the new 1450 Series Demodulators and 1405 Sideband Adapter are available to produce testing results with consistent accuracy. In the demodulators, Tektronix uses a Tektronix developed and manufactured Surface Acoustic Wave Filter and other advanced technology devices and construction techniques to achieve measurement quality performance. The Sideband Adapter, used with a Tektronix Spectrum Analyzer, plots an accurate sideband response curve, very useful for evaluating radio frequency and intermediate frequency circuits. With Tektronix Radio Frequency Products you can test and measure, not just estimate, the performance of your transmitting systems.

ANALYZERS AND CORRECTORS

Tektronix manufactures ANSWER — an automated video signal measurement system and automatic video correctors that help free valuable engineering personnel from routine system monitoring and adjustment.

ANSWER can automatically monitor and log video signal parameters of common carrier satellite and terrestrial systems, broadcast plants, and unattended TV transmitter systems. Tektronix Automatic Video Correctors automatically maintain the picture and synchronizing information at correct values, correcting ordinary changes and many severe distortions automatically.

To support your analyzers and correctors, you can choose from a variety of Tektronix Logic Analyzers and Display Products (monitors, terminals, and hard copy units).

DIGITAL CONVERTERS

Tektronix offers advanced analog to digital and digital to analog converters specifically designed for television in both ECL and TTL compatible versions. OEMs will be especially interested in the reliability and accuracy of these Tektronix-designed single circuit board converters. These quality digital units demonstrate our commitment to the advancement of communications technology.

GENERAL PURPOSE PRODUCTS FOR TV

When you work with signals other than composite video, other Tektronix products will interest you. This section provides an overview of these other products, plus some details about selected items of particular interest to the television industry and to users of television.

The complete reference for other Tektronix products is the General Catalog. To get the Tektronix General Catalog, use the response card in this TV Catalog (U.S. only), or contact your nearest Tektronix office, listed in this catalog.

SOURCES OF INFORMATION

ASSISTANCE

This catalog provides reasonably complete descriptions and specifications of Tektronix Television Products. For additional literature and answers to your questions, check with the Tektronix office in your area. See the listing of locations on the back cover.

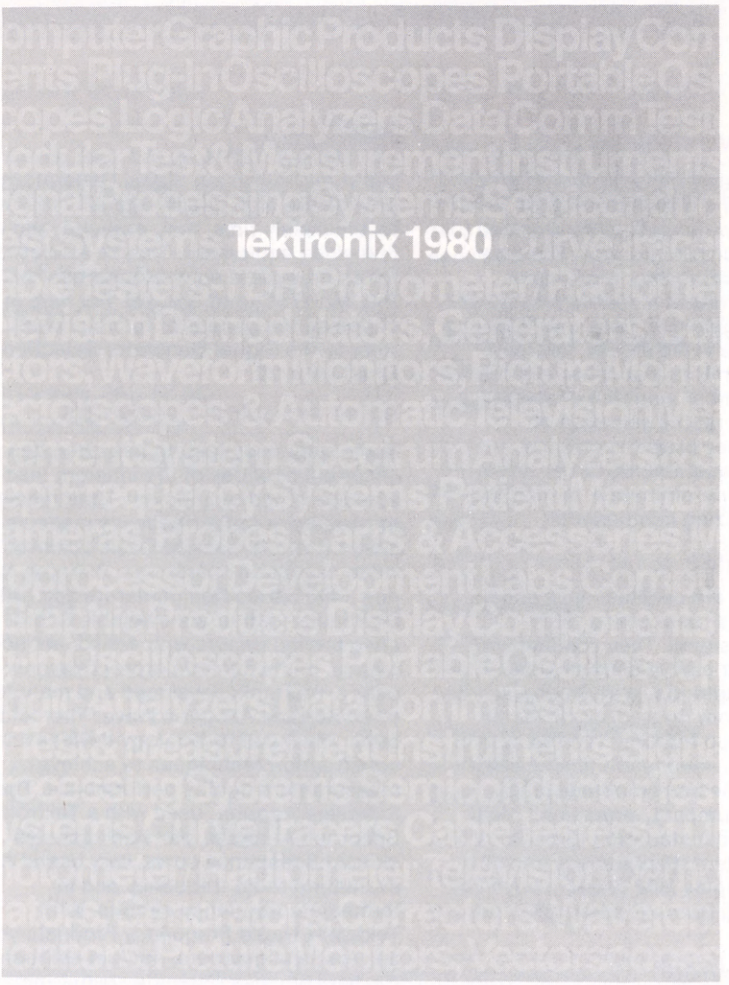
APPLICATION NOTES

As new applications arise, Tektronix provides application notes detailing these television measurement techniques. Your Tektronix Sales Engineer can supply you with application notes relevant to your needs.

MAILING LIST

In the U.S. we periodically mail application notes, catalogs, and other technical literature to people on our mailing list. If you'd like to receive these items, fill out and return the response card in this catalog.

TEKTRONIX GENERAL CATALOG



This catalog is filled with products for general test, measurement, and display applications. To get your copy, fill in and mail the response card in this TV Catalog (U.S. only). Or, contact your nearest Tektronix Field Office (listed on pages 93-95.).

GLOSSARY OF TELEVISION TERMS

ACTIVE VIDEO LINES
All video lines not occuring in the vertical blanking interval.

APL
The average signal level, with respect to blanking level, during the active picture scanning time expressed as a percentage of difference between blanking and reference white (IEEE Def).

BACK PORCH
That portion of the composite video signal lying between the trailing edge of the horizontal sync pulse and the trailing edge of the horizontal blanking pulse.

BLANKING LEVEL
The level of the composite picture signal separating the range containing picture information from the range containing synchronizing information (IEEE Def).

BREEZEWAY
The portion of the back porch between the trailing edge of the sync pulse and the start of the color burst.

BURST FLAG
A keying or gating signal used in forming the color burst from a chrominance subcarrier source (IEEE Def).

B-Y
A color difference signal obtained by subtracting the luminance signal from the blue camera signal. It is plotted on the 0° - 180° axis of a vector diagram.

CHROMINANCE SIGNAL
That portion of the color television signal containing the color information (STOC Def).

COLOR BAR
A test signal, typically containing six basic colors: yellow, cyan, green, magenta, red, and blue — used to check the chrominance functions of color TV systems.

COLOR BURST
In color systems, a burst of subcarrier frequency located on the back porch of the composite video signal. This serves as a color synchronizing signal to establish a frequency and phase reference for the chrominance signal.

COLOR SUBCARRIER
In color systems, the carrier signal whose modulation sidebands are added to the monochrome signals to convey color information.

COMPOSITE BLANKING
The complete television blanking signal composed of both line rate and field rate blanking signals (see also Line Blanking and Field Blanking).

COMPOSITE SYNC
The combined line and field rate synchronizing pulses (including field equalizing pulses).

COMPOSITE VIDEO
The color picture signal plus blanking and all synchronizing signals (STOC Def).

CONVERGENCE
In color television, the meeting or crossing of the three electron beams at the phosphor screen.

CROSSHATCH
A test pattern consisting of vertical and horizontal lines used for converging color monitors and cameras.

DIFFERENTIAL GAIN
The difference in output amplitude (expressed in percent or dB) of a small high frequency sine wave signal at two stated levels of a low frequency signal on which it is superimposed (IEEE Def).

DIFFERENTIAL PHASE
The difference in output phase of a small high frequency sine wave signal at two stated levels of a low frequency signal on which it is superimposed (IEEE Def).

EIA
An abbreviation for Electronic Industries Association.

EQUALIZING PULSES
Pulses of one half the width of the horizontal sync pulses transmitted at twice the rate of the horizontal sync pulses during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse. These pulses cause the vertical deflection to start at the same time in each interval, and also keep the horizontal sweep circuits in step during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse.

FIELD
One of the two (or more) equal parts of information in which a frame is divided in interlace scanning.

FIELD BLANKING
The blanking signals occurring at the end of each field, used to make the vertical retrace invisible. Also called vertical blanking.

FIELD FREQUENCY
The rate at which one complete field is scanned.

FRAME
One complete picture consisting of two fields of interlaced scanning lines.

FRONT PORCH
That portion of the composite picture signal lying between the leading edge of the horizontal blanking pulse and the leading edge of the corresponding horizontal sync pulse.

H RATE
The time for scanning one complete horizontal line, including trace and retrace.

HORIZONTAL DRIVE
A pulse at horizontal rate used in TV cameras. Its leading edge is coincident with the leading edge of the horizontal blanking pulse, and the trailing edge is coincident with the trailing edge of the horizontal sync pulse (NTSC only).

HUE
The attribute of color perception that determines whether the color is red, yellow, green, blue, etc.

IRE
An abbreviation for Institute of Radio Engineers.

IRE SCALE
An oscilloscope scale that applies to composite video levels. There are 140 IRE units in 1 V.

— I, W, Q, B
An NTSC test signal used to check television broadcast equipment. It consists of a — I signal followed by a white bar, then a Q signal and a black level on each line.

LINE BLANKING
The blanking signal at the end of each horizontal scanning line. Used to make the horizontal retrace invisible. Also called horizontal blanking.

LINE FREQUENCY
The number of horizontal scans per second, normally 15,734.26 times per second for NTSC color systems.

LUMINANCE
The amount of light intensity perceived by the eye as brightness (referred to as "Y").

NTSC
National Television Systems Committee. An industry-wide engineering group which, during 1950-1953, developed the color television specifications now established in the United States.

REFERENCE WHITE LEVEL
The level corresponding to the specified maximum excursion of the luminance signal in the white direction.

R-Y
A color difference signal obtained by subtracting the luminance signal from the red camera signal. It is plotted on the 90° - 270° axis of a vector diagram.

SATURATION
Indicates to what degree a color is diluted by white light.

SETUP
The separation in level between blanking and reference black levels.

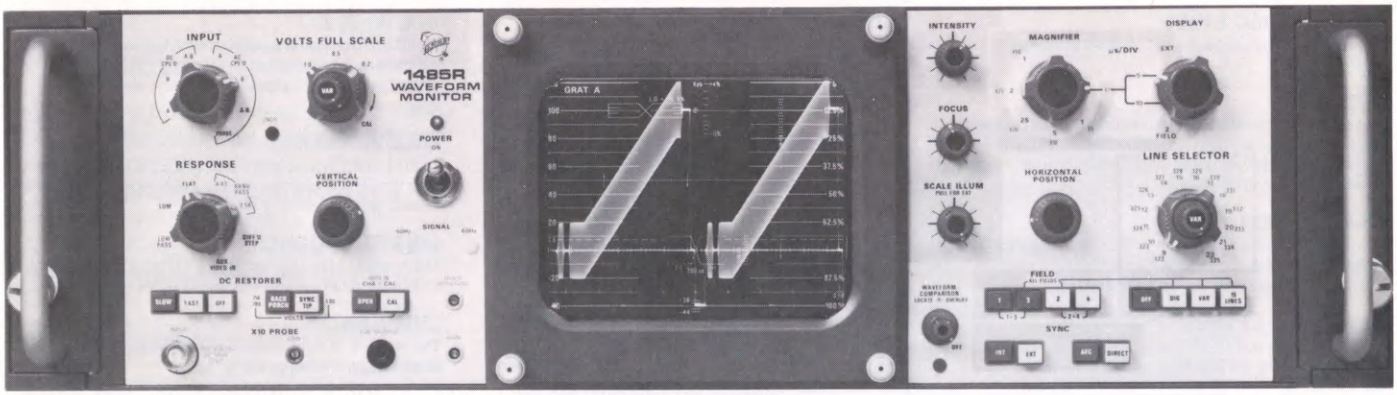
STAIRCASE
A video test signal containing several steps at increasing luminance levels. The staircase signal is usually amplitude modulated by a subcarrier frequency and is useful for checking amplitude and phase linearities in video systems.

SYNC
An abbreviation for "synchronization," "synchronizing," etc. Applies to the synchronization signals, or timing pulses, which lock the electron beam of the picture monitors in step, both horizontally and vertically, with the electron beam of the pickup tube. The color sync signal (NTSC) is known as the color burst.

VERTICAL BLANKING INTERVAL
The blanking portion at the beginning of each field. It contains the equalizing pulses, the vertical sync pulses, and VITS (if desired).

VITS
Vertical interval test signal. A signal that may be included during the vertical blanking interval to permit on-the-air testing of the video system.

1480 SERIES WAVEFORM MONITORS



1485R Option 01 PAL/NTSC Dual Standard Waveform Monitor (Rackmount)

Bright CRT especially suitable for vertical interval testing

Advanced measurement modes

Amplitude measurement accuracy approaching 0.2%

Digital selection of line and field

Probe input option

15 line display for VTR applications

THE 1480 SERIES OF WAVEFORM MONITORS

There are 1480 Series Monitors for PAL, PAL-M, NTSC, and SECAM. Dual standard units are also available. The differences between the monitors in the series are essentially confined to what lines in the vertical interval are selectable, what vertical amplifier response modes are available, and to the field selection modes. Dual-Standard Monitors automatically recognize the signal standard in use and indicate that standard on the front panel.

VERTICAL INTERVAL TESTING

The bright CRT of the 1480 Series eliminates many of the VITS monitoring difficulties associated with previous waveform monitors. CRT brightness is sufficient to allow you to easily see one Vertical Interval Test Signal selected out of four fields, even in a well-lighted area. This solution to VITS display problems required the design of a very high light-output CRT — only one of the unique features of the 1480 Series.

MORE ACCURACY, GREATER RESOLUTION

The 1480's provide several advanced measurements modes for more accuracy. These allow you to make amplitude measurements to an accuracy approaching 0.2%. In one mode, a precision display offset is used. A proven video measurement technique, offsetting displays with an amplitude standard is an easy-to-use method that achieves accuracy by eliminating parallax and transfer errors. Transfer errors are eliminated because the signal is compared to a precise 1 V standard rather than to graticule calibration. Measurements made with comparison techniques also are highly consistent and repeatable. When the signal precisely matches the standard, signal amplitude will be determined to the value and accuracy of the offset. The tolerance of the internal calibration signal used as the standard is 0.2%.

Resolving power is important in achieving precise amplitude measurements. The 1480's provide great resolving power through calibrated X5 expansion of the vertical display. Expansion means that signal and standard comparison is more precise and the differences (errors) between signal and standard are easier to see and measure.

A vernier position control facilitates greater resolution of the X5 expansion. With this control, you can position any portion of a standard amplitude signal on screen and then examine it in detail. A 0.2% amplitude standard, X5 expansion offset comparison, and fine CRT spot size are a few of the many factors that make the 1480's very accurate video signal monitoring instruments.

A MODE FOR SIDE-BY-SIDE COMPARISON

We call this mode overlay or sweep foldback. The 1480's can actually overlay a later segment of a display on an earlier segment. Superimposing waveforms over other waveforms allows exact comparison of levels. Overlay allows exact comparison of the elements of complex vertical interval test signals. Add the extra resolving power of X5 vertical expansion with precision offset and the overlay mode reaches its full potential.

SURE LINE SELECTION, POSITIVE FIELD IDENTIFICATION

The overlay mode is just one of the advances in 1480 time-base functions. Digital selection of field and line assures positive identification of displayed information. For example, selection of line 18 of field 2 assures display of line 18, field 2. Digital techniques will not allow an incorrect selection.

Variable selection of other lines is provided for full-field signal analysis. The 15-line mode is provided for working with quadruplex VTRs. In all line selection modes, a line intensifying strobe is provided with video for picture monitor displays. A second line strobe output is provided to strobe 520 Series Vectorscopes, etc. Intensified two-field displays on the 1480 help to locate the line or lines selected.

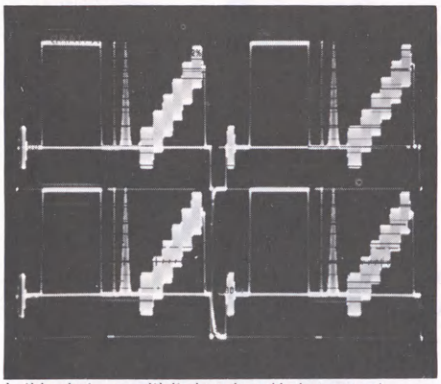
15-LINE DISPLAY FOR VTR APPLICATIONS

With the 15-line mode, the 1480's are particularly well suited for examining head by head performance of a quadruplex videotape recorder. Without the conflicting pattern of signals from other heads, the 1480 easily displays time base instability, jitter, distorted sync pulses, missing sync pulses, and field time distortions. Also, the 1480 line strobe is very useful in selecting only the output from an individual head for measurement by a Tektronix 520 Series Vectorscope. That makes it possible to measure chrominance phasing, differential phase, and differential gain.

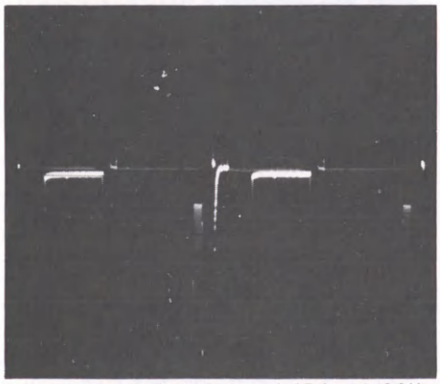
RESPONSE SELECTION AND A UNIQUE AUXILIARY MODE

Many television measurements require the filtering of some components from the composite signal. For example, luminance signal rejection by 3.58 MHz or 4.43 MHz subcarrier filters for differential gain measurements. A selection of appropriate filters is provided in the 1480's, including low pass, IRE, subcarrier, and one for staircase linearity measurements called differentiated staircase. When specialized or unique measurements require a special filter, you may insert that filter between the auxiliary video output and auxiliary input. The auxiliary video input mode, selected by the response control, allows you to add a filter or other device without breaking into the program line. The auxiliary video input and output are buffered by amplifiers to provide a precise 75 Ω source and load.

DISPLAY OFFSET
. . . compare the signal to a precise 1 V standard for accurate results.

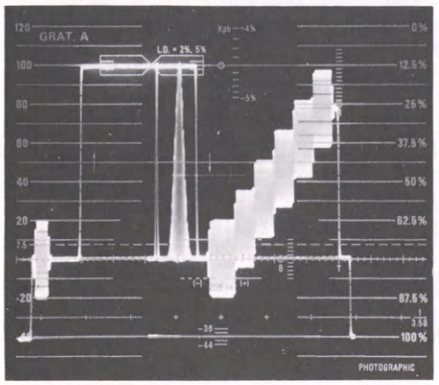


In this photo, sensitivity is reduced below normal operating values to show how OFFSET places the top of one display on the same level as the bottom of another display of the same signal. Since the top and bottom line up, the signal equals the offset standard.



In this photo, scale factor is expanded 5 times to 0.2 V full scale. Offset used with X5 expansion provides exceptional resolving power plus comparison accuracy. The signal shown is 10% high.

OVERLAY (SWEEP FOLDBACK)
. . . overlay signal elements for side-by-side comparison.



Pulse and Bar overlaid for precise comparison. Use expansion for more resolution. TV Application Notes fully detail Offset and Overlay Techniques.

GRATICULES, FOCUS AND INTENSITY, AND FACTORS AFFECTING DISPLAYS

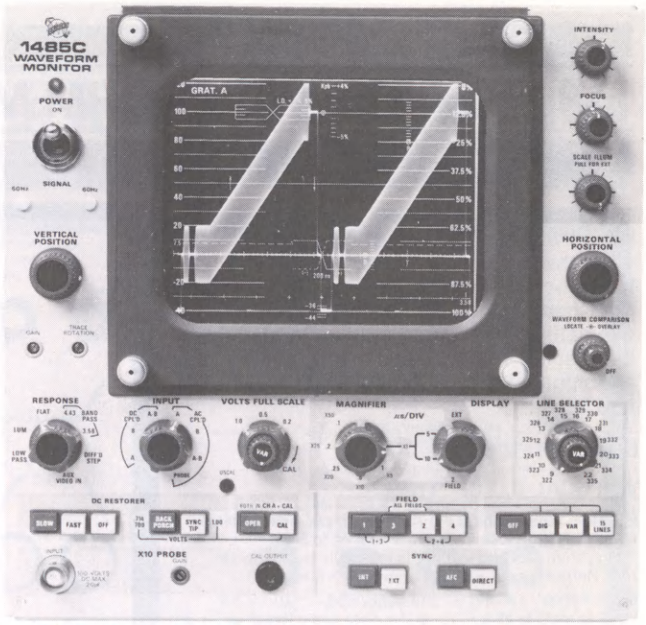
Two graticules are provided. One, internal and illuminated, is used for most applications. An internal graticule has no parallax. The other graticule is external and can be easily changed, a feature useful for special applications. The external graticule is illuminated by a separate system. The internal graticule is not visible when external graticule illumination is selected.

In the 1480 Series, monitor focus and brightness levels are automatically compensated for when switching from a two field setting to a faster time base.

The fastest sweep time is 0.1 μs per division, fast enough and bright enough to examine T pulses. The 1480's are calibrated in μs with a basic 1% time base accuracy (2% when using the magnifier). X50 is the greatest range of magnification with steps of 10, 5, 2 and 1.

The sync recognizer has two modes: AFC and Direct. This provides a way to display jitter or to stabilize a jittery display.

Other improvements provided by the 1480's include slow dc restoration, which will display any hum present, or a fast mode to filter out hum so you can make measurements more accurately. Also selectable are backporch or sync tip dc restoration. A dc coupled input mode is provided for measuring diode demodulator output and other applications.



1485C Option 01 PAL/NTSC Dual Standard Waveform Monitor (Cabinet).

WORKING IMPEDANCES OTHER THAN 75 Ω . . . A PROBE OPTION (OPTION 01)

A Probe Option for the 1480's makes convenient high impedance probing available. This option provides an input that accepts most Tektronix Probes. With this option, a probe compensation waveform test point is provided. A X10 amplifier keeps full screen sensitivities at 1.0 V, 0.5 V, and 0.2 V while you use X10 attenuator probes.

OPTION 06

The 1480R Option 06 is a high-performance television waveform monitor designed for use in a television operating center. Option 06 is especially designed for measurements in long distance video transmission systems using 124 Ω balanced lines. Self-normalizing WECO-style input jacks allow this monitor to operate in a 75 Ω system without externally terminating the ring input.

OPTION 07 SLOW SWEEP

In the 1480 Series Option 07 Waveform Monitor, random sampling techniques are employed to display long time distortions. Sampling maintains display intensity at a level suitable for viewing and photography. Long time distortions occur over a longer period of time than the field rate, generally one-half to several seconds. The signal most often used for long time distortion testing is a flat field video signal with a changing Average Picture Level (APL). This method, called "Bump" or "Bounce" testing, requires a signal level change at selected intervals, usually 1 to 10 seconds. The effect is then viewed on a waveform monitor with a sweep speed of 5 to 10 seconds per sweep. When the waveform monitor is triggered by the change in APL, you can track the effect of the change for up to 10 seconds after the change has occurred.

A 1480 Series Option 07 in the slow sweep mode is triggered from APL change. You may select either + polarity, starting the slow sweep on the transition from at or near black level to peak or near peak white, or – polarity, white to black. In addition, you can choose either internal (stripped from incoming video) or external (through the External Sync Inputs) trigger sources. If insufficient or no trigger is present, the slow sweep will operate in a free-run mode, which has a noticeably reduced repetition rate. The sweep duration and linearity are unchanged.

The sweep duration is controlled by a variable front-panel control, located on the display switch. Range of control over the duration of the sweep is approximately 4 to 15 seconds.

You can easily determine the status of the sweep by observing the waveform comparison indicator light. In the slow sweep mode, the lamp is lit during the intervals between sweeps and goes out during actual sweep time. This feature is valuable for either waveform photography or for determining sweep timing.

1480 SERIES WAVEFORM MONITORS

1480 Series instruments with Option 07 can be triggered by a 50-60 Hz square wave that has no field sync and filtered line sync. This mode of operation has its own loop-through rear panel input. You can activate this mode by simultaneously depressing both Internal and External Sync pushbuttons. Display duration is two fields.

CHARACTERISTICS

VERTICAL DEFLECTION

Inputs — Input A and B are 75 Ω high impedance loop-through. Return loss is ≥ 40 dB from dc to 5 MHz in a 75 Ω system. Aux Video input is internally terminated in 75 Ω. Return loss is ≥ 34 dB from dc to 5 MHz.

Scale Factor — A and B input calibrated — 1.0, 0.5, 0.2 V full scale. Variable — range for each scale factor ≥ +40% to −50%. Aux Video Input 1.5 dB gain.

Max Input Voltage — 2 V peak-to-peak (ac coupled).

Frequency Response — Flat — Flat to 5 MHz ±2%; 5 MHz to 10 MHz + 2%, −5%. Low Pass — Attenuation ≥ 14 dB, 500 kHz and above. 3.58 MHz Band Pass — Amplitude within ± 1% of amplitude in Flat response position. **Bandpass** ≈ 600 kHz. 4.43 MHz Band Pass — Amplitude within ±1% of amplitude in Flat response position. Bandpass ≈ 600 kHz. IRE — Conforms to IRE Standard 23S-1 1958 amended.

DC Restorer — Keyed type, may be turned off. Clamping point: BACK PORCH/SYNC TIP. Time constant: FAST reduces mains hum ≥ 26 dB, SLOW reduces mains hum < 1 dB.

Calibrator — Amplitude selected by dc Restorer switch. Sync Tip — 1 V ± 0.2%. Back Porch — 714 mV or 700 mV ± 0.5%.

Nonlinear Distortion — Differential gain ≤ 0.5%.

Linear Waveform Distortion — Pulse/bar ratio ± 1%. SHORT TIME: preshoot, overshoot, ringing ≤ 0.5% on 100 ns sin² pulse. LINE TIME: Tilt or rounding ≤ 0.5%. FIELD TIME: (ac coupled) ≤ 1%.

HORIZONTAL DEFLECTION

Time-Base — 5 μs and 10 μs/div; ± 1% over center 10 divisions. 1 μs, 0.5 μs, 0.25 μs, 0.2 μs, and 0.1 μs/div: ± 2% over center 10 divisions. 2 FIELD ≈ 12.7 divisions.

External Sync Input — Two loop-through high impedance, with ≥ 46 dB return loss in a 75 Ω system. Inputs are slaved to A and B video inputs or to A external sync only.

External Sync Input Requirements — 400 mV to 2 V composite video or 200 mV to 8 V composite sync.

Line Selector — DIG — Selects lines 9 to 22 NTSC, line 9/322 to line 22/335 PAL, line 9/272 to line 22/285 PAL-M. VAR — ≈ line 20 of the selected field through the next field and to line 8 of the following vertical blanking interval. 15 lines — Identical to VAR, except 15 successive lines are displayed.

Sync — AFC; Horizontal frequency range is 15.75 kHz ± 200 Hz. Max jitter with respect to input sync 10 ns (30 ns with 4 V rms hum plus −36 dB white noise). Direct: Horizontal frequency ≤ 20 kHz. Max jitter with respect to input sync 12 ns (90 ns with 4 V rms hum plus — 36 dB white noise).

Field Selector — Positive selection of Field 1 or 2 in the NTSC system. Positive selection of 1, 2, 3, 4, or 1 & 3, 2 & 4, in the PAL systems.

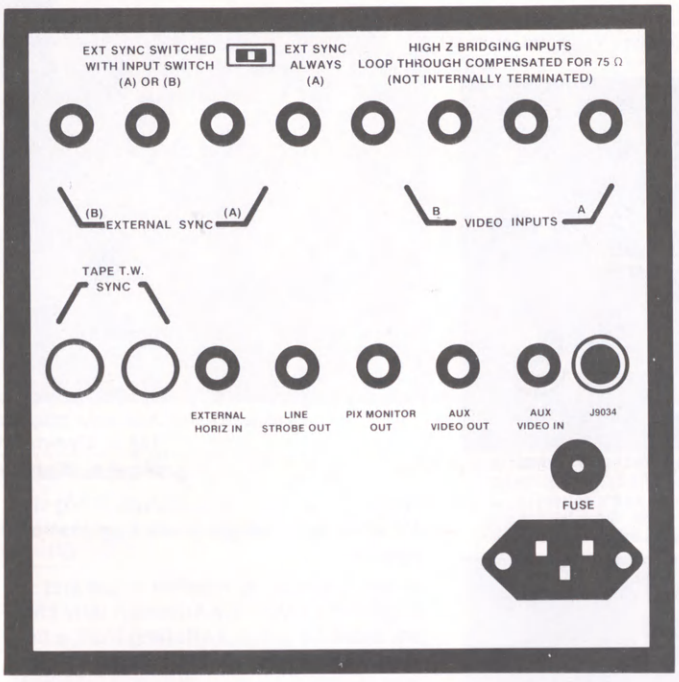
OPTION 08 (SECAM field identification)

Field Reference Pulse Input — Amplitude: 2.4 V min, 4.5 V max p-p. Input impedance: ≈ 1 kΩ ac coupled. Pulse timing: Positive going transition must occur between line 9 of field 4 and end of line 7 of field one. Pulse width: 3 μs min. Pulse rise time: 1 μs max.

The 12.5 Hz output of the 143 and the Field One Reference Pulse output of the 653HR and 656HR are compatible with this input.

OUTPUTS

Line Strobe — TTL amplitude pulse. Pulse coincident with line or lines selected by VAR, 15 LINE or DIG modes of DISPLAY switch.


EXT SYNC SWITCHED WITH INPUT SWITCH (A) OR (B)
EXT SYNC ALWAYS (A)
HIGH Z BRIDGING INPUTS LOOP THROUGH COMPENSATED FOR 75 Ω (NOT INTERNALLY TERMINATED)
(B) EXTERNAL SYNC (A)
B VIDEO INPUTS A
TAPE T.W. SYNC
EXTERNAL HORIZ IN
LINE STROBE OUT
PIX MONITOR OUT
AUX VIDEO OUT
AUX VIDEO IN
J9034
FUSE

1485C Rear Panel

Rear Panel Inputs BNC
- Video A Loop-Through
- Video B Loop-Through
- External Sync A Loop-Through
- External Sync B Loop-Through
- External Horizontal
- Auxiliary Video

Rear Panel Outputs BNC
- Line Strobe
- Pix Monitor
- Auxiliary Video

Picture Monitor — Output of incoming video with LINE STROBE added. Output impedance is 75 Ω. Output adjusted to unity with respect to A and B video input.

Aux Video — Output of incoming video. 75 Ω output impedance. Gain adjustable to unity with respect to A and B video input.

OTHER CHARACTERISTICS

RGB/YRGB Staircase Input — ≈ 12 V for 12.7 divisions' deflection. RGB sweep length internally selected for 1/3 normal sweep. YRGB sweep length internally selected for 1/4 normal sweep length.

Mains Voltage — Ranges: 100 V ac, 110 V ac, 120 V ac, 200 V ac, 220 V ac, 240 V ac ± 10%. Frequency: 48 Hz to 62 Hz. Max power consumption 75 W. At factory, 1480 preset for 110 V ac. 1481, 1485 preset 220 V ac. 1482 preset for 115 V ac.

OPTION 01

10X Probe Channel — Scale Factor 1 V, 0.5 V, 0.2 V full screen with 10X attenuator probe. GAIN range ± 10%. Tilt ≤5% on 50 Hz square wave. High frequency response ±2%, 25 Hz to 5 MHz. +3%, −5%, 5 MHz to 10 MHz. Referenced to 50 kHz. Input resistance 1 MΩ, ± 2%, not including probe. Input RC Product 20 μs, ± 0.5%, not including probe. BNC connector accepts most Tektronix probes.

10X Probe Calibrator — Output voltage 1.000 V ± 0.005 V or 0.995 to 1.005 V.

SLOW SWEEP (Option 07)

Duration — 4 to 15 s, variable with front panel control.

Linearity — ±5% of full-screen over the length of the sweep.

Indicator — Front-panel indicator on when slow sweep is operating but sweep is not running.

Triggering Signal — APL change ≤10% to 90% (Bump or Bounce), front panel selectable for either + or − level change.

Sensitivity — 400 mV to 2 V p-p composite video with APL change.

Rate — ≥0.2 Hz, free-runs at rates <0.2 Hz or with no triggering signal.

Input — Internal or External. 50/60 Hz Square wave Triggering — Sensitivity: 400 mV p-p min 3 V p-p max. Input Impedance: 10 kΩ ac coupled (Rear Panel loop-through connectors not return loss compensated.)

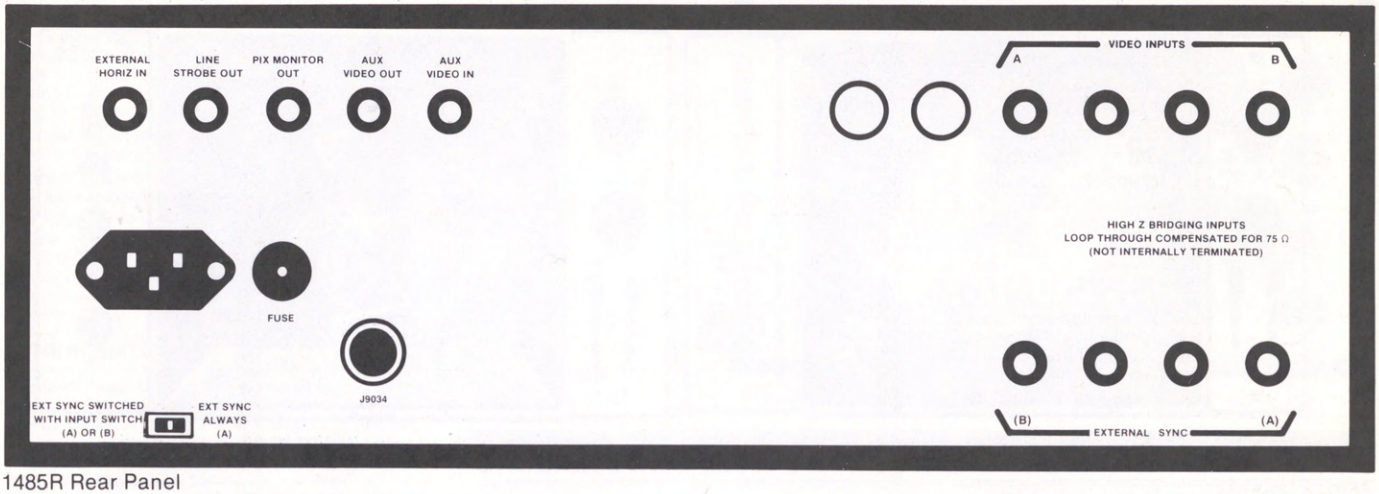
DIMENSIONS AND WEIGHTS

	Cabinet		Rackmount	
	in	cm	in	cm
Height	8.25	21.0	5.25	13.3
Width	8.50	21.6	19.0	48.2
Depth	16.95	43.0	18.0	45.7
	lb	kg	lb	kg
Net	21.5	9.8	24.6	11.2
Shipping	28.5	12.9	53.1	24.1

Included Accessories — 351-0195-00 Slide, SWR, Ext Slide Pair (Rackmount Only). 103-0031-00 (2 each) Adapter, Right Angle BNC.

A BNC to multi-pin connector adapter is provided as a standard accessory for connecting the incoming reference signal to the 1481/1485 when Option 08 is ordered.

1480 SERIES WAVEFORM MONITORS



1485R Rear Panel

ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

1480C NTSC Waveform Monitor

1480R NTSC Waveform Monitor

1481C PAL Waveform Monitor *

1481R PAL Waveform Monitor *

1482C PAL-M Waveform Monitor

1482R PAL-M Waveform Monitor

1485C PAL/NTSC Dual Standard Waveform Monitor *

1485R PAL/NTSC Dual Standard Waveform Monitor *

Option 01 1 MΩ, 20 pF Probe Input (probe not included) Suggested Probe: P6108 10X Probe, 2 m order **010-6108-03,** 3 m order **010-6108-05.**

Option 02 With Carrying Case (Cabinet Version Only).

Option 03 With Blank CRT.

Option 04 Tone Wheel Sync (1480C, 1481C, 1482C, and 1485C only. Replaces 529 or T04 in some RCA VTRs — Check with RCA for retrofit compatibility).

Option 05 Tone Wheel Sync (1485C only — check with RCA for retrofit compatibility).

Option 06 124 Ω WECO Style Inputs (1480R only).

Option 07 Slow Sweep. **

Option 08 SECAM Field Identification (1481C, 1481R, 1485C and 1485R only).

*1481C/R, 1485C/R meets European Broadcast Union Tech. 3221-E, Guiding Principles for design of Television Waveform Monitors.
**Option 07 satisfies EBU Tech. 3221-E §3.2.2.

OPTIONAL ACCESSORIES

Mounting Cradles — A cradle assembly, with associated bezel, lets you mount the 1480C Waveform Monitor alongside a 9 in. Conrac Picture Monitor in a standard 19 in. rack. A cradle and bezel are also available for mounting two 1480s side-by-side.

For mounting 9 in. SNA-9 Picture Monitor (Requires 8¾ in. rack space).

Cradle Assembly **014-0020-00**

Bezel, for mounting 1480C on operator's left . **014-0023-00**

Bezel, for mounting 1480C on operator's right **014-0024-00**

For mounting two 1480C Waveform Monitors side-by-side (requires 8¾ in. rack space)

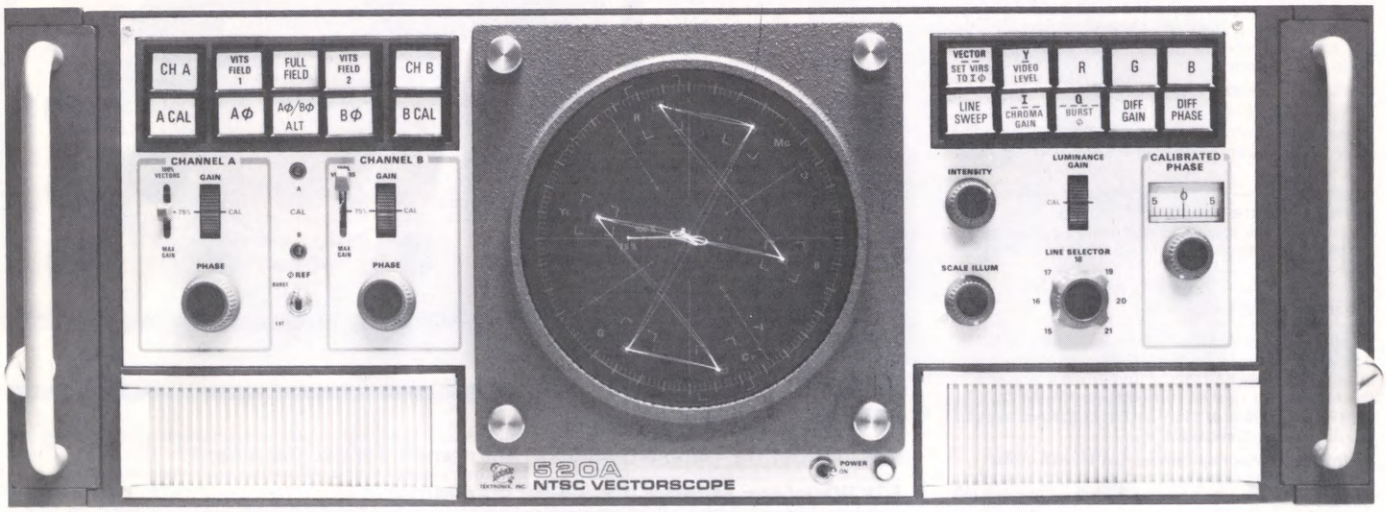
Cradle Assembly **014-0020-00**

Bezel **014-0022-00**

1480R Cradle Assembly — For mounting the 1480R in a WECO backless rack **426-0309-00**

C-59P recommended for display photos. See Camera section of the Tektronix Products Catalog.

520A (NTSC), 521A (PAL), and 522A (PAL-M) VECTORSCOPES



R520A NTSC (525/60 3.58 MHz).

MEASUREMENTS

Luminance amplitude

Chrominance amplitude and phase

Differential phase

Differential gain

VECTOR DISPLAYS

The vector display shows the relative phase and amplitude of the chrominance signal on polar coordinates. To help identify these coordinates, the graticule has points corresponding to the proper phase and amplitude of the primary and complementary colors: R (Red), B (Blue), G (Green), C_Y (Cyan), Y_L (Yellow), and M_G (Magenta).

Any errors in the color encoding, videotape recording, or transmission processes which change these phase and/or amplitude relationships cause color errors in the television picture. Polar coordinate displays, such as those obtained on the 520A, 521A, and 522A CRT, have proved to be the best method for showing these errors.

The polar display permits measurement of hue in terms of relative phase of the chrominance signal with respect to the color burst. Amplitude is expressed in terms of the displacement from center (radial length) toward the color point which corresponds to 75% (or 100%) amplitude of the particular color being measured.

The outer boxes around the color points correspond to phase and amplitude error limits (± 10°, ± 20%). For the 520A (NTSC) the inner boxes indicate ± 2.5° and 2.5 IRE units, and correspond to phase and amplitude error limits per EIA specification RS-189, amended for 7.5% setup. For the 521A (PAL) and 522A (PAL-M), the inner boxes indicate ± 3° phase angle and ± 5% amplitude.

An internally generated test circle, used with the vector graticule, verifies quadrature accuracy, horizontal to vertical gain balance, and gain calibration for chrominance signal amplitude measurements. Two methods of measuring phase shifts are provided. You can accurately read large phase shifts from the parallax-free vector graticule. A precision calibrated phase shifter with a range of 30°, spread over 30 in. of dial length, is provided for measuring small phase shifts.

DUAL VECTOR DISPLAYS

In dual-channel operation, successive samples of channels A and B are displayed on a time-shared basis. The switching rate is locked to horizontal sync, and switching transients are blanked. You can conveniently compare input/output signals from video equipment on channel A or B for phase and/or amplitude distortion.

The subcarrier processing channel contains two uncalibrated 0° to 360° phase-shifters and one 30° CALIBRATED PHASE shifter. While viewing channel A or B, you can switch either of the uncalibrated phase-shifters, A∅ or B∅, into the subcarrier processing channel. Each phase shifter locks to its respective channel when A and B channels are time-shared, permitting independent phase control of the channel A and B displays. Unequal signal paths causing phase shifts are easily cancelled, leaving only phase and amplitude distortion caused by equipment deficiencies.

Video cable lengths may be accurately matched for time delay at color subcarrier frequency to less than 0.5° phase difference.

You can make accurate amplitude measurements of chrominance and luminance from the CRT display. Use the internal 1 V luminance amplitude calibration test signal to check the gain accuracy of channel A and B amplifiers and the luminance channel.

TIME BASE DISPLAYS

The linear time base operates at the line rate. Color signals may be demodulated along any desired axis, I, Q, and R-Y (for NTSC), and U, and V (for PAL and PAL-M), and displayed at the line rate on a linear time base.

As displayed on 520A

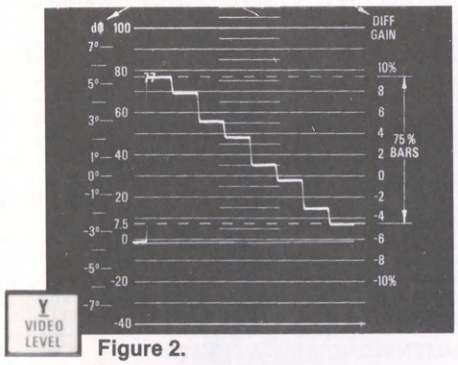


Figure 2.

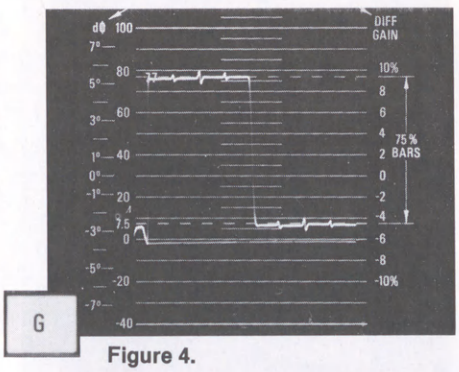


Figure 4.

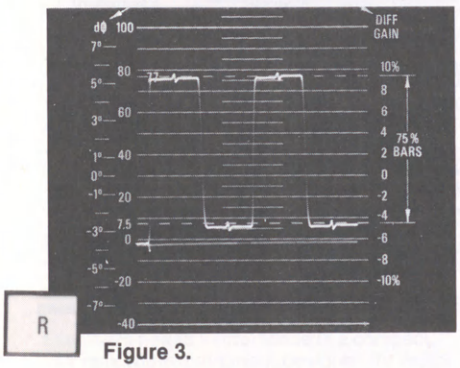


Figure 3.

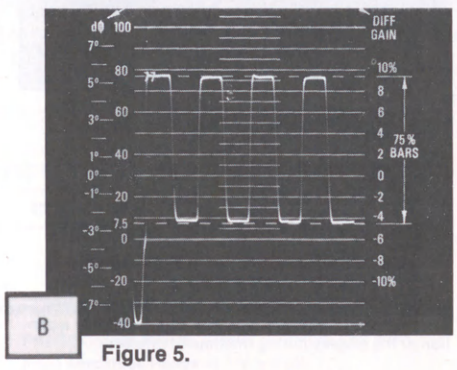


Figure 5.

75% amplitude Color Bar Signal displayed on the line sweep graticule. Pushbuttons select line-sweep displays of luminance (fig 2), decoded Red (fig 3), decoded Green (fig 4), and decoded Blue (fig 5).

RED (R), GREEN (G), BLUE (B), and LUMINANCE (Y)

The 520A, 521A, and 522A provide a luminance channel that permits the separation and display of the luminance (Y) component from the composite color signal (fig. 2). You can also combine the Y component with the output of the chrominance demodulators for R, G, and B displays at a line rate (fig. 3, 4, 5). You can make amplitude measurements of color signal components with an accuracy of 3%.

VERTICAL INTERVAL TEST SIGNAL OBSERVATION

You can display vertical Interval Test Signals from front-panel selected lines of either field 1 or 2 on the 520A Vectorscope. For the 521A (PAL) and the 522A (PAL-M), you can display ITS from either fields 1 and 3 or fields 2 and 4.

Binary counters operate in conjunction with the field selector to select lines in either field that may carry suitable test signals. These circuits let you use the vectorscope for measuring differential gain and differential phase from test signals transmitted in the vertical blanking interval.

DIFFERENTIAL GAIN AND DIFFERENTIAL PHASE MEASUREMENTS

The two main chrominance signal distortions — differential gain and differential phase — can be measured on the 520A (NTSC), 521A (PAL), and 522A (PAL-M) Vectorscopes. Differential gain (fig. 6) is a change in color subcarrier amplitude as a function of luminance level. In the reproduced color picture, saturation will be distorted in the areas between the light and dark portions of the scene. When you're making a differential gain measurement, the luminance graticule's major divisions represent percent of voltage gain or loss. The 520A, 521A, and 522A permit differential gain measurements with accuracy to better than 1%.

Differential phase (fig. 7) is a phase modulation of the chrominance signal caused by changes in the luminance signal level. The hue will vary with scene brightness in the reproduced color picture. Differential gain and differential phase occur separately or together. You can read differential phase errors from the precision calibrated phase shift control or directly from the differential phase markings on the graticule.

TWO METHODS OF MEASURING DIFFERENTIAL PHASE

Small differential phase distortions, such as those found in studio systems, laboratories, or on individual equipment, are most accurately measured by the two-trace overlay method as shown in fig. 7. The vertical deflection of the display is greatly magnified and inverted on alternate lines, allowing the use of a trace overlay technique and the slide-back method for measuring small phase changes. Using the CALIBRATED PHASE control, you can measure differential phase to 0.2°.

A second direct-reading method (fig. 8) is better suited for larger differential phase measurements such as those required in videotape recorders and microwave links.

650HR COLOR PICTURE MONITORS

650HR High Resolution Color Monitor.

High resolution Trinitron*

Variable aperture correction

Precise color tracking over full signal range

Two switchable inputs isolated from ground for hum rejection

External sync switching capability

Differential (A-B) inputs for sync timing and burst phasing adjustments.

NTSC, PAL, and Dual Standard versions — RGB inputs optional

Rapid retrace — entire active picture area can be displayed in underscan

Precision decoding — outputs may be used to present vector displays on X-Y oscilloscopes

Unique "blue only" capability for optimizing VTR settings

The Tektronix 650HR Series Color Picture Monitors are designed for exacting applications where picture quality is particularly important. The 650HR offers the features and capabilities of earlier Tektronix 650 Series Color Monitors and adds a high resolution Trinitron* CRT and improved decoder. The improved CRT features 50% more phosphor stripes than before, and the decoder gives wider (1.2 MHz) bandwidths for even greater detail.

The 650HR offers stability and simplicity of convergence, and will produce a consistently sharp, geometrically accurate picture. The 12 in. Trinitron* Kinescope is free from many of the moire problems of other designs.

Picture sharpness in the 650HR Series is enhanced by variable aperture correction. You can choose the amount of correction desired with a continuously variable front-panel control. The control has a detented position that is factory preset for optimum display of the vertical crosshatch lines. With an internal adjustment, you can change the preset value to a setting of your own choice.

The unique Blue Only mode ties the blue drive signal to the red, green, and blue channels simultaneously. This provides a monochrome display with a high sensitivity to VTR noise and banding problems.

Circuits in the Tektronix 650HR Series are designed for color stability and consistency. Outputs are provided from the precision decoders and may be used to drive an X-Y monitor for a vector display. The regulated EHT supply is not affected by extreme changes in APL even when calibrated brightness, at peak white, is set at 30 fL. Raster size is held within 1%, while excellent clamping maintains a stable black level with a 0 to 100% range of APL.

Horizontal retrace is $< 10\ \mu s$, less than the usual horizontal blanking interval. The rapid retrace lets you view (in reduced-size mode) the entire active video area. During retrace, the 650HR Series monitors clamp video to the preadjusted black level. Time constants are chosen so that any hum component of the video signal will be displayed.

All signal connections to the 650HR monitors are made through BNC coaxial connectors located on the sloping rear panel of the instrument. Two connectors for each input provide compensated loop-through connections, so you can connect the instrument into any part of a 75 Ω system.

Two external composite sync inputs are also provided. You may select automatic switching between the two external sync signal sources as the video input is switched or, sync for both video inputs from one of the two sync inputs. All inputs are isolated from each other and the chassis.

The MODE switch controls whether or not the chrominance channel is activated. In the AUTO mode, the chrominance channel is activated by the presence of burst. In the COLOR mode, the chrominance channel is activated whether burst is present or not. In the MONOCHROME mode, the chrominance channel is deactivated at all times.

In all Tektronix Color Monitors, you can shift the picture either horizontally or vertically, or both (pulse cross). This lets you monitor sync, burst, blanking, vertical interval test and reference signals. When the monitor is operating in any of these display modes, brightness is automatically advanced to permit observation of the sync pulses and burst. Expansion of the vertical scan is provided in the pulse cross and vertical delay modes, so you can view individual lines in the vertical blanking interval.

The 650HR Series Monitors can be used in rack installations or separately in their own cabinets. They're compact, requiring only 10.5 in. (27.6 cm) vertically. Versions are available for NTSC and PAL systems. Dual standard and RGB input versions are also available.

CHARACTERISTICS

Input Signal Level — 0.5 V p-p min composite video 2 V p-p max. (Exceeds CCIR recommendations 567, part D and D.2.)

Impedance — Unterminated: High Z bridging inputs loop-through compensated for 75 Ω (not internally terminated). Return Loss: ≥ 46 dB to 5 MHz, power on or off, input in use or not.

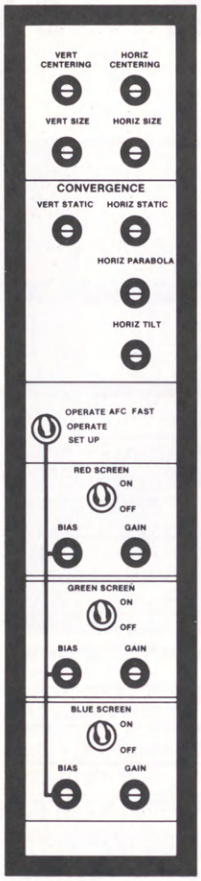
Maximum Safe Input — Exceeds CCIR Recommendation 451-2 (± 5 V peak).

Hum Rejection — Hum is ≥ 50 dB down when 4 V max RMS common mode mains hum signal is applied to the monitor in floating ground mode.

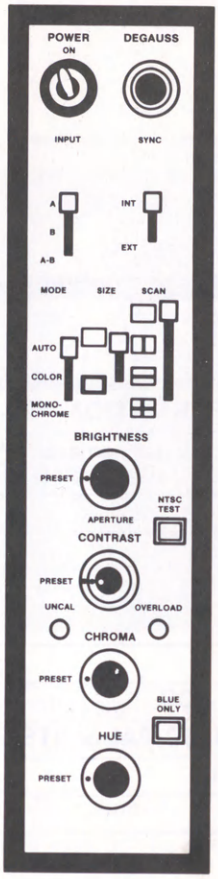
NTSC Luminance Channel — Bandwidth (notch filter removed) > 6 MHz. Subcarrier notch filter automatically removed when burst is not present and MODE switch is in AUTO position. Subcarrier notch filter removed when MODE switch is in Monochrome position. Dc Restoration back porch type; not affected by burst. Mains hum reduction due to dc restorer is < 6 dB. Amplitude Linearity: within 2%.

*Trinitron is a registered trade name of Sony Corporation.

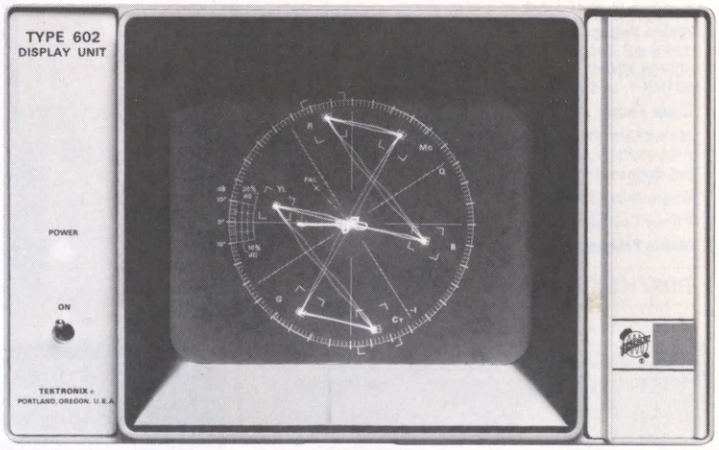
650HR SERIES COLOR PICTURE MONITORS



Left Panel — Convergence is simple in the 650HR Series. Adjustments are located behind a locked panel door.



Right Panel Operational Controls — The variable aperture control is concentric with the contrast control.



Accurate vector displays on X-Y oscilloscopes such as the Tektronix 602 Option 05 are made possible by the precision decoder outputs on Tektronix 650HR Series Monitors.

NTSC Chrominance Channel — Demodulation Axis: R-Y, B-Y. Bandpass: 0.6 MHz equiband. Gain Range: preset at 0 dB; adjustable from −6 dB to +10 dB. Bandwidth: 1.3 MHz.

PAL Luminance Channel — Bandwidth (notch filter removed) >5 MHz. Subcarrier notch filter can be removed by changing internal jumper. Subcarrier notch filter normally left in circuit.

PAL Chrominance Channel — Demodulation Axis: U, V. Bandwidth: 1.2 MHz. Bandpass: ≈1.2 MHz. Gain Range: Preset at 0 dB; adjustable from −6 dB to 10 dB.

Residual Subcarrier Detection (on applied signal) — Color of displayed picture will shift due to any residual subcarrier. This feature can be inhibited by a jumper on the decoder board.

Chrominance/luminance — Time Error: <50 ns. Gain Error: <3%.

Delay — Red to green to blue <50 ns.

Subcarrier Regeneration — Phase Error: within 1° with input burst variation of ±10 Hz from subcarrier nominal burst level. With Temperature Variation: within 5° with ambient temperature variation from 0°C to 50°C; with 1°, for any 10°C increment within the range 0°C to 50°C. With Input Signal Variation: within 1° with input signal variations of ±3 dB from 1.0 V, within 3° with variation of burst/sync ratio of −6 dB to +10 dB. Breezeway Stability: ≤0.2° for burst timing errors including burst width variance (8-11 cycles), and breezeway variance +0.28 μs. Phase Error Due to Noise: within 1° with RMS white noise at −24 dB (0 dB = 700 mV RMS).

PICTURE

Height — 7.2 in. (184 mm).

Width — 9.6 in. (244 mm).

Underscan — ≈10% reduction in both height and width.

Aspect Ratio — 3:4.

Deflection Linearity — Vertical and Horizontal: +1% of picture height within a central area bounded by a circle whose diameter equals picture height, ±2% of picture height outside of central area.

Convergence Error — <1 mm within the central area. Outside of the central area, color separation (misconvergence) is <2 mm.

Unblanking — All active picture elements are displayed. (Horizontal retrace is accomplished within 10 μs.)

Color Temperature — 6500°K. Easily adjustable to other standards.

Calibrated Contrast — 30 fL at peak white of standard 1 V signal.

Calibrated Brightness — Displayed black may be preset to a level appropriate for ambient conditions.

EHT (Extremely High Tension) — 19 kV nominal, regulated. Load variations cause <1% picture size variation. Monitor conforms to Department of Health, Education and Welfare regulations 21 CFR Part 278, Subpart C, applicable on date of manufacture.

Kinescope Protection — Failure of horizontal or vertical scanning shuts off the EHT. Failure of H.V. Regulator circuit does not cause EHT to soar excessively. EHT supply is current limited.

Heater Voltage — Regulated dc.

SYNC AND TIMING

Signal Range — Composite sync 0.5 V p-p to 8 V p-p or composite video 0.5 V p-p to 2 V p-p.

Impedance — Unterminated: High Z bridging inputs loop-through compensated for 75 Ω (not internally terminated). Terminated: 75 Ω Return Loss: ≥46 dB to 5 MHz with respect to 75 Ω.

Synchronization — Stable subcarrier regeneration, limited by line sync performance. Line sync white noise immunity is 20 dB. Field sync white noise immunity is 20 dB. Field sync stable with tilt equal to 100% of sync amplitude in vertical blanking. Stable with 20 IRE mains hum.

AFC (two loop AFC Type) — Phase Corrector: corrects for phase errors due to side pincushion correction and other effects within the monitor. Slow AFC: displays timing errors of incoming sync, particularly, 60 Hz or 240 Hz timing errors. Bandwidth is ≈25 Hz. Fast AFC: largely corrects for incoming sync errors, ≈2 kHz bandwidth.

Scan Delay — Horizontal Delay: ≈¼ line; displays burst. Vertical Delay: displays the vertical blanking interval of the input signal expanded ≈2.5 times unless underscan is activated. If the underscan button is depressed, vertical expand is inhibited.

650HR SERIES

POWER SUPPLY

Mains Voltage Range — 115 V: within 10% (104 V ac to 126 V ac). 230 V: within 10% (207 V ac to 253 V ac). 650HR, 650HR-1 are factory set for 115 V. 651HR, 651HR-1, and 655HR are factory set for 230 V.

Crest Factor — ≥ 1.3.

Mains Current — 1.5 A RMS max at 115 V, 60 Hz. 0.75 A max at 230 V, 50 Hz. Current is substantially higher during degaussing.

Degaussing Surge Current — 5 A RMS.

Power Consumption — 150 W max, 110 W typical.

Mains Frequency — 48 Hz to 66 Hz.

DIMENSIONS AND WEIGHTS

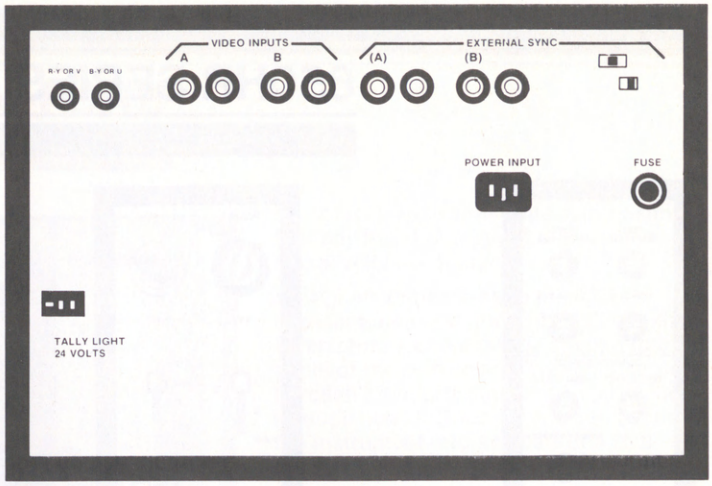
	Cabinet		Rackmount	
	in	cm	in	cm
Height	11.0	27.9	10.46	26.6
Width	16.75	42.6	19.0	48.3
Length (w/handles*)	16.5	41.9	*18.25	*46.4
	lb	kg	lb	kg
Net	52.0	23.5	52.0	23.5
Domestic Shipping	67.0	30.4	67.0	30.4
Export Shipping	82.0	37.2	82.0	37.2

ENVIRONMENTAL

Temperature — Nonoperating, −40 °C to +65 °C. Operating range, 0 °C to +50 °C.

Altitude — Nonoperating: to 50,000 ft. Operating range: to 15,000 ft.

Shock — To 30 g's, ½ sine, 11 ms duration.



Rear Panel

650HR ORDERING INFORMATION

When ordering, please use the exact nomenclature given here. All 650HR Monitors are shipped with rackmounting hardware. Cabinet version hardware is also included.

650HR NTSC

650HR-1 NTSC + RGB

651HR PAL

651HR-1 PAL + RGB

655HR NTSC + PAL

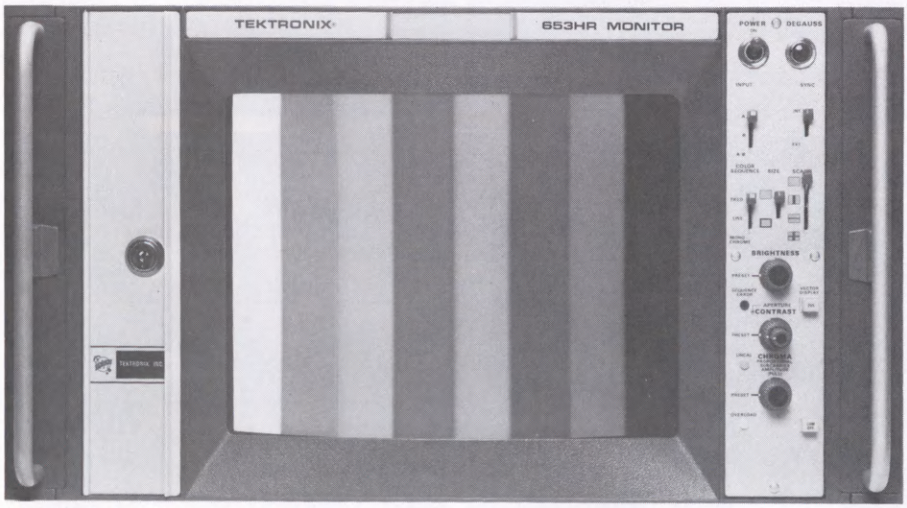
655HR-1 NTSC + PAL + RGB

For Vector Display with NTSC, PAL or NTSC + PAL Monitors

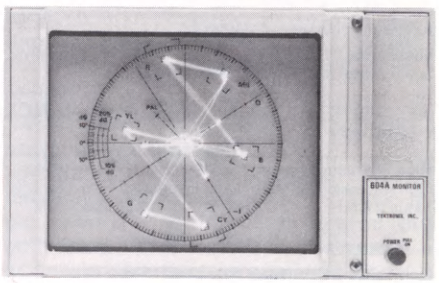
602 Option 05 Display Unit

604A Option 05 Monitor

653HR SERIES SECAM COLOR PICTURE MONITORS



653HR Color Picture Monitor.



Color sequencing from field identification signals or line burst

Precision decoding allows use of R-Y, B-Y outputs for vector display measurements

RGB inputs with vector display outputs (optional)

PAL/SECAM version available (656HR) with front panel control of decoding standard

Variable aperture correction

Vertical and horizontal delay display modes

Reduced chrominance line crawl

Indicates color sequence error

Rapid retrace — entire picture area is displayed in reduced scan

Two switchable inputs isolated from ground for hum rejection

Tektronix SECAM Color Picture Monitors are identical to the 650HR Series except they're specially designed for use on SECAM systems. They are available in versions for SECAM (653HR), SECAM + RGB (653HR-1), SECAM/PAL (656HR) and SECAM/PAL + RGB (656HR-1).

All monitors provide unique measurement possibilities and are designed for exacting applications. For example, with an auxiliary vector display, encoding tolerances (including white reference quality) are displayed for both 75% and 25% amplitude color bars. You can observe encoder-limiting action on field indentification signals and encoder transient behavior.

Color sequencing is front panel controlled by a three position mode switch. In the Field mode, field identification signals are used for color sequencing and a color display is enabled by the presence of detectable field identification signals. In the Line mode, line burst determines color sequence, and a color display is enabled whenever detectable SECAM subcarrier is present. Use of the Monochrome mode blanks the chrominance channel.

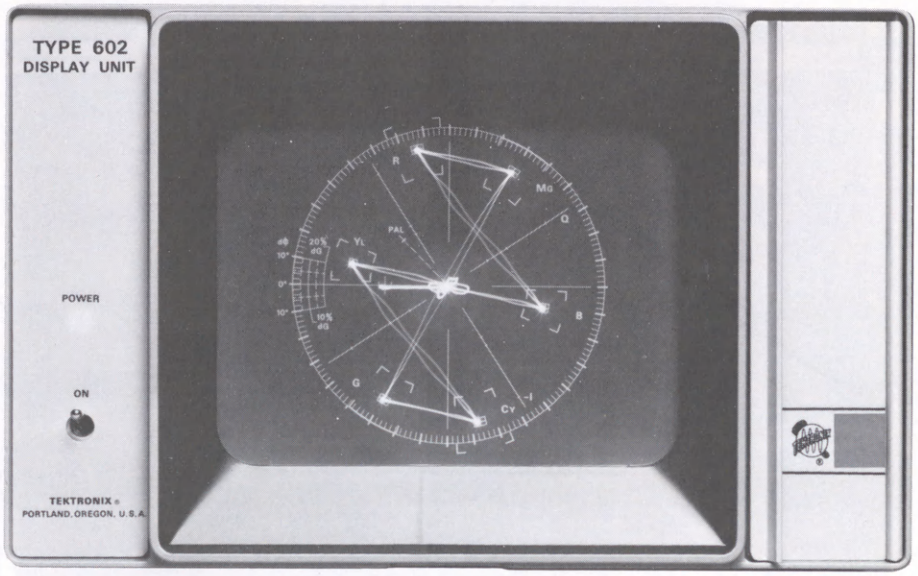
In the internally selectable Forced-Color mode, the very high limiting ratio of the chrominance channel lets you use the Tektronix 653HR Series Monitors to search for very small amounts of crosstalk or other unwanted signals. By displaying the chrominance portion of such signals on a brightened display, you can easily identify the source.

Two PROMs (programmable read only memories) are used in the Tektronix 653HR Series Monitors for generating accurate timing signals. Their use eliminates the need for many internal adjustments and possible drift related to the timing of internal signals. One of these PROMs is programmed with information corresponding to the lines containing subcarrier (including field identification lines) in 625/50 SECAM systems. The Monitor then serves as a check on improper additions or deletions of lines that might possibly occur in improperly adjusted VTRs, processing amplifiers, and switchers.

Chrominance line crawl is greatly reduced by using separate acoustical delay lines; one for D'R and one for D'B. With front panel controls, you can turn off luminance or chrominance, and examine each one separately. Brightness is automatically advanced for easier viewing when luminance is turned off for examination of chrominance. For purity checks, you can set up the equivalent of a flat field display by switching luminance off in a monochrome mode (chrominance off).

The monitor's chroma control has two operating modes. When the control is in, the chrominance is independent of subcarrier amplitude. When the control is out, the chrominance is proportional to subcarrier amplitude. In the first case, the saturation will vary with incoming video level. In the latter case, correct saturation will be maintained for varying signal levels. In either mode, both a preset (detent) position and a variable range are available. Switching between the two modes in the preset position provides an indication of abnormal chrominance or luminance amplitude.

670A SERIES COLOR PICTURE MONITORS



Precise decoding allows 670A Series Monitors with Option 02 to provide vector displays on an X-Y oscilloscope such as the Tektronix 602 Option 05.

CHARACTERISTICS

Input Signal Level — 0.5 V p-p min composite video; 2 V p-p max.

Impedance — Unterminated: High Z bridging inputs loop-through compensated for 75 Ω (not internally terminated). Return Loss: ≥ 46 dB to 5 MHz, power on or off, input in use or not.

Maximum Safe Input — Exceeds CCIR Recommendation 567, part D and D.2 (± 5 V peak).

Hum Rejection — Hum is ≥ 50 dB down when 4 V max RMS mains hum signal is applied to the monitor in floating ground mode.

Luminance Channel — Dc Restoration: back porch type; not affected by burst. Mains hum reduction due to dc restorer is < 6 dB. Amplitude Linearity: within 2%.

Chrominance Channel — Demodulation Axis: R-Y, B-Y. Bandpass: 0.6 MHz equiband. Gain Range: preset at 0 dB; adjustable from − 6 dB to + 10 dB.

Residual Subcarrier Detection (on applied signal) — Color of displayed picture will shift due to any residual subcarrier. This feature can be inhibited by a jumper on the decoder board.

Chrominance-Luminance — Time error: < 50 ns. Gain Error: < 3%.

Delay — Red to green to blue: < 50 ns.

Subcarrier Regeneration — Phase Error: within 1° with input burst variation of ± 10 Hz from subcarrier nominal burst level. With Temperature Variation: within 5° with ambient temperature variation from 0 °C to 50 °C; within 1°, for any 10 °C increment within the range 0 °C to 50 °C. With Input Signal Variation: within 1° with input signal variations of ± 2 dB from 1.0 V. Within 3° with variation of burst/sync ratio of − 6 dB to + 10 dB. Breezeway Stability: ≤ 0.2° for burst timing errors including burst width variance (8-11 cycles), and breezeway variance ± 0.28 μs. Phase Error Due to Noise: within 1° with RMS white noise at − 24 dB (0 dB = 700 mV RMS).

PICTURE

Height — 10.1 in. (256 mm).

Width — 13.5 in. (342 mm).

Underscan — ≈ 10% reduction in both height and width.

Aspect Ratio — 3:4.

Deflection Linearity — Vertical and Horizontal: ± 1% of picture height within a central area bounded by a circle whose diameter equals picture height, ± 2% of picture height outside of central area.

Convergence Error — < 1 mm within the central area. Outside of the central area, color separation (misconvergence) is < 2 mm.

Unblanking — All active picture elements are displayed. Horizontal retrace is accomplished within 10 μs.

Color Temperature — 6500 °K. Easily adjustable to other standards.

Calibrated Contrast — 30 fl at peak white of standard 1 V signal.

Calibrated Brightness — Displayed black may be preset to a level appropriate for ambient conditions.

EHT (Extremely High Tension) — 24 kV nominal, regulated. Load variations cause < 1% of picture size variation. Monitor conforms to Department of Health, Education and Welfare regulations 21 CFR Part 278, Subpart C, applicable on date of manufacture.

Kinescope Protection — Failure of horizontal or vertical scanning shuts off the EHT. Failure of H.V. Regulator circuit does not cause EHT to soar excessively. EHT supply is current limited.

Heater Voltage — Regulated dc.

SYNC AND TIMING

Signal Range — Composite sync 0.5 V p-p to 8 V p-p or composite video 0.5 V p-p to 2 V p-p.

Impedance — Unterminated: High Z bridging inputs loop-through compensated for 75 Ω (not internally terminated). Terminated: 75 Ω. Return Loss: ≥ 46 dB to 5 MHz with respect to 75 Ω.

Synchronization — Stable subcarrier regeneration, limited by line sync performance. Line sync white noise immunity is − 20 dB. Field sync white noise immunity is − 20 dB. Field sync stable with tilt equal to 100% of sync amplitude in vertical blanking. Stable with 20 IRE mains hum.

AFC (Two-Loop AFC Type) — Phase Corrector: corrects for phase errors due to side pincushion correction and other effects within the monitor. Slow AFC: displays timing errors of incoming sync; particularly, 60 Hz or 240 Hz timing errors. Bandwidth is ≈ 25 Hz. Fast AFC: largely corrects for incoming sync errors, ≈ 2 kHz bandwidth.

Scan Delay — Horizontal Delay: ≈ ¼ line; displays burst. Vertical Delay: displays the vertical blanking interval of the input signal expanded ≈ 2.5 times unless underscan is activated. If the underscan button is depressed, vertical expand is inhibited.

POWER SUPPLY

Mains Voltage Range — 115 V: within 10% (104 V ac to 126 V ac). 230 V: within 10% (207 V ac to 253 V ac).

Crest Factor — ≥ 1.3.

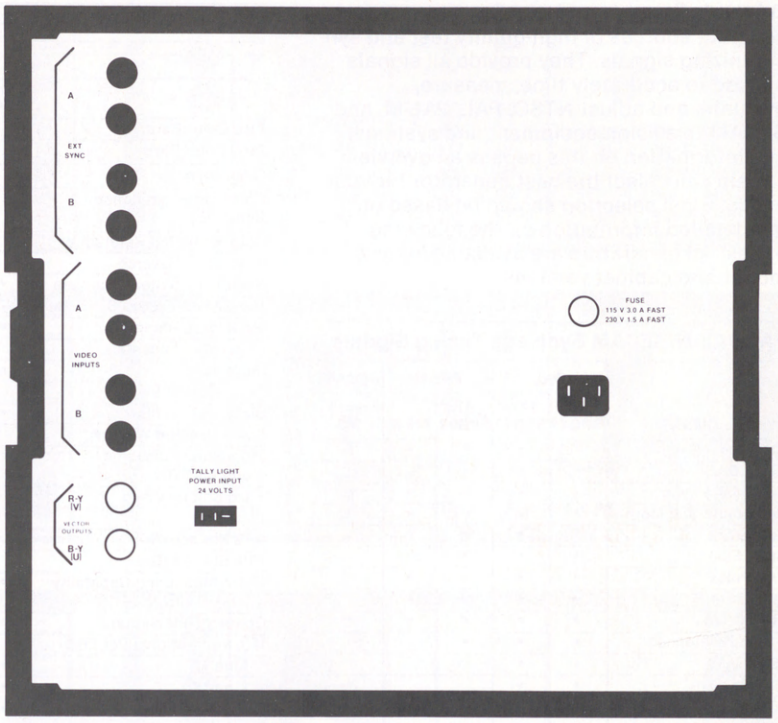
Mains Current — 2.5 A RMS max at 115 V, 60 Hz. 1 A max at 230 V, 50 Hz. Current is substantially higher during degaussing.

Degaussing Surge Current — 5 A RMS.

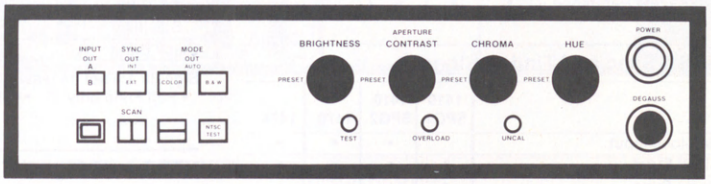
Power Consumption — 230 W max, 185 W typical.

Mains Frequency — 48 Hz to 66 Hz.

670A SERIES COLOR PICTURE MONITORS



670A and 671A rear panel.



Operational controls — The variable aperture control is concentric with the contrast control.

DIMENSIONS AND WEIGHTS

	Cabinet		Rackmount	
	in	**cm**	**in**	**cm**
Height	16.0	40.6	15.72	39.9
Width	17.45	44.32	19.0	48.26
Length (w/handles*)	20.75	52.7	*21.725	*55.18
	lb	**kg**	**lb**	**kg**
Net	89.0	40.4	89.0	40.4
Domestic Shipping	107.0	48.5	107.0	48.5
Export Shipping	132.0	59.9	132.0	59.9

ENVIRONMENTAL

Temperature — Nonoperating: −40 °C to +65 °C Operating range: 0 °C to +50 °C.

Altitude — Nonoperating: to 50,000 ft. Operating range: to 15,000 ft.

Shock — To 30 g's, ½ sine, 11 ms duration.

All 670A Monitors are shipped with rackmounting hardware. Cabinet version hardware is also included.

ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

670A NTSC

670A-1 NTSC + RGB

671A PAL

For Vector Display Options on 670A Series Monitors Order Option 02

602 Option 05 (X-Y Monitor)

604A Option 05 (X-Y Monitor)

INCLUDED ACCESSORIES — Cable assembly, pwr: 3 wire, 98 in. (161-0066-00); Slide guide: pair (351-0395-00); Label set: tally indent (334-1935-00); 4 ft: plastic (348-0080-01); 4 Screw, matching: 6-32 x 0.312 in. 100 deg, flh stl (211-0538-00); Removal tool: anode (003-0728-00).

SIGNAL GENERATOR SELECTION CHART

Tektronix Television Signal Generators are compact sources of high-quality test and synchronizing signals. They provide all signals needed to accurately time, measure, evaluate, and adjust NTSC, PAL, PAL-M, and SECAM television equipment and systems. The information on this page is an overview to help you select the best generator for your needs. Final selection should be based on the detailed information on the following pages. All generators are available in rack-mount and cabinet versions.

PAL/PAL-M/SECAM Sync and Timing Signals

	PAL		PAL-M		SECAM
SYNC & TIMING	1411 SPG11	1411 SPG12	1412 SPG22	145-M	143
Gen-lock Input		•	•	•	•
Black Burst	•	•	•		
Composite Sync	•	•	•	•	•
Composite Blanking	•	•	•	•	•
Subcarrier	•	•	•	•	
Burst Flag	•	•	•	•	
PAL Pulse	•	•	•	•	
Line Drive	•	•	•	•	•
Field Drive	•	•	•	•	•
1 MHz Reference	•	•	•		
25 Hz	•	•			
12.5 Hz	•	•			•
30 Hz			•	•	
15 Hz			•	•	
7.8 kHz					•
Color Field Reference	•	•	•		

NTSC Sync and Timing Signals

	1410 SPG1	1410 SPG2	1470	1474
Gen-lock Input		•	•	•
Black Burst	•	•	•	•
Comp Sync	•	•	•	•
Subcarrier	•	•	•	•
Comp Blanking	•	•	•	•
Burst Flag	•	•	•	•
H Drive	•	•	•	•
V Drive	•	•	•	•
Color Field Reference	•	•		

NTSC sync, timing is in accordance with Electronic Industries Association (EIA) RS-170-A, dated 8 Nov 77.

625/50 sync, timing subcarrier in accordance with CCIR Rec. 624-1.

PAL/PAL-M/SECAM Test Signals

				PAL				PAL-M			SECAM
	148	TSG11	TSP11 TSG12	TSG13	TSG14	TSG15	TSG16	145-M	148-M	1412	143
EBU Color Bars		•								•	•
RGB Color Bars											•
Color Bars		•						•		•	
Color Bars/Luminance Reference		•						•		•	
Color Bars/Red Reference		•						•		•	
Color Bars/Reverse		•								•	
Modulated 5 Step Staircase	••			•				•	••	•	
Modulated 10 Step Staircase	••			•				•	••	•	
Modulated Ramp	••			•					••	•	
Modulated Pedestal				•				•		•	
Multiburst	••						•		••		
Frequency Sweep							•		•		
Sin² Pulse and Bar	••					•			••		
Sin² Pulse and Window	•					•					
Modulated Pulse and Modulated Bar						•					
Field Square Wave	•					•			•		
Flat Field	•			•					•	•	•
APL Bounce (AC)	•			•					•	•	
APL Bounce (DC)				•						•	
Noise Measuring Capability	••								ITS ONLY		
Convergence Signal			•					•		•	•
ITS, International Per EBU											
Line 17	••										
Line 18	••										
Line 330	••										
Line 331	••										
CCIR-I									••		
CCIR-II									••		
SIG-III									••		
Black Burst					•						

Signals are not necessarily simultaneous and a few require simple reprogramming

• Full Field only •• ITS plus Full Field

NTSC Test Signals

	TSG1	TSP1 TSG2	TSG3	TSG4	TSG5	TSG6	SPG1 SPG2	1470	147A	149A
VIRS				•			*		VITS ONLY	VITS ONLY
EIA Colors Bars	•									
Full-Field Color Bars	•							•		••
Color Bars Y/Ref	•									•
Color Bars Red/Ref	•									
Color Bars/Reverse	•									
Red Field								•		
Blue Field								•		
Green Field								•		
Modulated 5-Step Staircase			•					•	••	••
Modulated 10-Step Staircase			•						••	••
Modulated Ramp			•						••	••
Modulated Pedestal			•							••
Composite Test Signal									••	••
Convergence Signal		•						•		
Black Burst				•			•	•		
Full/Reduced Amplitude Multi Burst						•		•	••	••
Frequency Sweep						•				
Sin² Pulse and Bar					•				••	••
Sin² Pulse and Window					•			1	•	••
Modulated Pulse and Modulated Bar					•					
Field Square Wave					•				•	•
Noise Measuring Capability									•	
Flat Field/Variable Level			•						•	•
APL Bounce (AC)			•						•	•
APL Bounce (DC)			•							
Test Signal/Variable APL			•						•	•

A few signals may require reprogramming and some signals may not be available simultaneously.

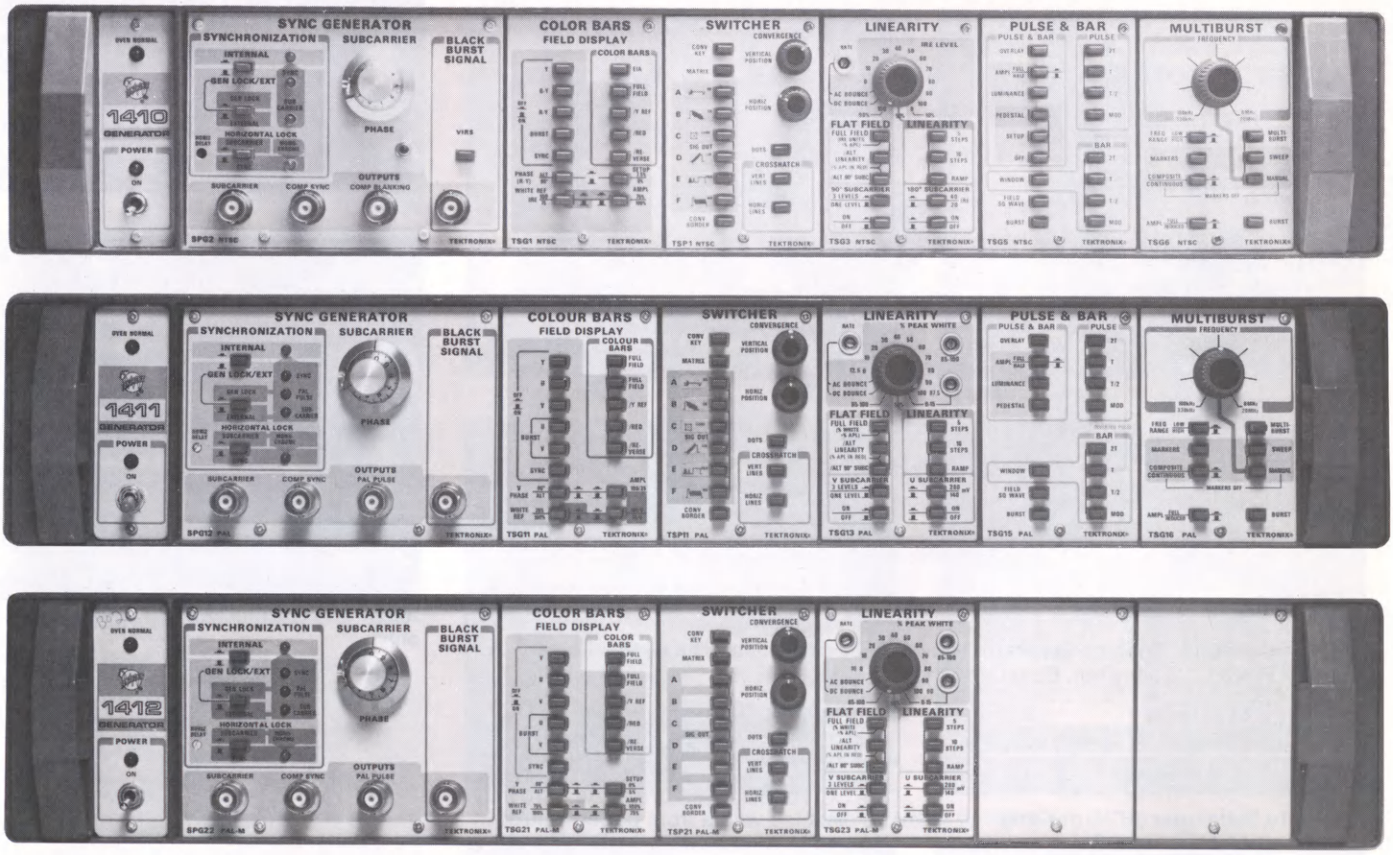
Test Signals:

1) Window only

• Full-Field Signal •• Full-Field signal, also available as VITS.

* As a line 19 signal on the Black Burst output.

1410 NTSC/1411 PAL/1412 PAL-M SERIES GENERATORS



Card set construction —

Save by selecting just the functions you need now

Add functions as you need them

Two sync generators/one timing generator

Six test signal generators and one switcher

The 1410 NTSC, 1411 PAL, and 1412 PAL-M Series Sync Pulse and Test Signal Generators are functionally identical within the specifications of each television system. They all offer versatile card-set construction that gives you the advantages of configurability at prices generally associated with single-piece units. With each series you have access to a wide selection of sync pulse and test signal generators that can be combined with the mainframe in the color standard of your choice. If you need additional test signal capabilities in the future, our flexible card sets assure retrofit capability for you.

MAINFRAMES

The mainframe unit for each generator series includes the power supply, an extender board, an interface board, and color-standard circuitry. Two color-standard circuits are available for the 1410. The standard 1410 Mainframe generates chrominance subcarrier at 3.579545 MHz ±10 Hz. An Option 01 Mainframe generates chrominance subcarrier at 3.579545 MHz ±1 Hz. The color standard circuitry for the PAL 1411 Mainframe has a chrominance subcarrier frequency of 4.43361875 MHz ±1 Hz. The color standard for the PAL-M 1412 Mainframe has a chrominance subcarrier frequency of 3.57561149 MHz ±1 Hz.

Each ±1 Hz color standard has a proportional control oven for the oscillator circuit. A front-panel lamp indicates proper operation of the oven.

Unless otherwise indicated by a statement enclosed by parentheses ( ), all information and descriptions of the 1410 NTSC Series and its generators applies equally to equivalent mainframes or generators for the 1411 PAL and 1412 PAL-M Series. Information in parentheses applies only to the specified series.

GENERATORS

The Sync Pulse and Test Signal Generators for each series fit onto their respective mainframe interface board. Front-panel controls and switches are mounted on the generator circuit boards with removable extenders projecting through the front panels.

Choose from two sync pulse generators or one timing generator, and test signal generators for color bars, convergence pattern, linearity signal, pulse and bar, multiburst and sweep, plus a switcher/convergence generator.

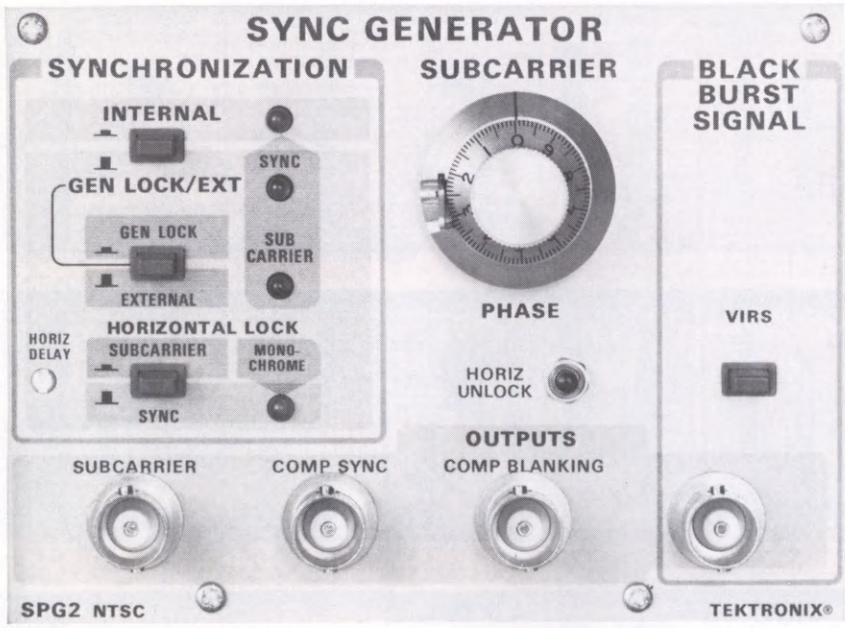
SYNC PULSE AND TIMING GENERATORS

Sync pulse and timing generators offered for each standard are: the SPG1, SPG2, and SPG3 for the 1410 NTSC Series; the SPG11, SPG12, and SPG13 for the 1411 PAL Series; and the SPG22 for the 1412 PAL-M Series.

They perform three basic functions:

- Provide all the usual color sync generator functions and outputs including color framing (SPG3 and SPG13 excluded).
- Provide the timing signals for the test signal generators installed.
- Provide a black burst signal (SPG3 and SPG13 excluded).

SYNCHRONIZATION



The SPG2 (SPG12, 22) Sync Generator has gen-lock capablility. The almost identical SPG1 (SPG11) does not. Generator shown actual size.

BROADCAST QUALITY SYNC PULSE GENERATORS

SPG1 (SPG11, 21) and SPG2 (SPG12, 22)

- **Sync to Subcarrier (SCH) phasing maintained or corrected**
- **Color Frame Reference Output**
- **Genlock to Composite Video (SPG2, SPG12, SPG22)**
- **Lock to External References**
- **Adjustable Blanking Widths**

The SPG1 (SPG11) and SPG2 (SPG12, 22) are high quality sync generators designed for use in systems where accuracy, stability, SCH phasing capability, and lockup mode versatility are of prime importance.

The SPG1 (SPG11) and SPG2 (SPG12, 22) use either internally generated or externally supplied subcarrier for color standard reference. Subcarrier source is front panel selectable.

Two external synchronization modes, external reference or genlock, are available. In the genlock mode (SPG2, 12, 22, only), line, field, subcarrier, and PAL pulse (SPG12, 22 only) timing are derived from the incoming composite video signal. In the external reference mode, line, field, subcarrier, and PAL pulse timing is derived from individual reference signals applied to the generator.

In the genlock and external reference modes, the generator sync and subcarrier outputs remain SCH phased whether the incoming reference signal(s) is SCH phased or not. This is made possible by locking the generator color subcarrier to the reference color subcarrier and referencing generator line and field sync signal timing to subcarrier rather than line and field sync on the incoming reference signal(s). This feature is of value in editing and program assembly applications. A color frame identification pulse output identifies field 1 of the color field sequence. Should the user desire, the SCH phasing feature of the 1410 may be disabled with a front panel control. In this mode of operation, the SCH phasing of the incoming signal is maintained by locking subcarrier to incoming burst and sync to incoming sync.

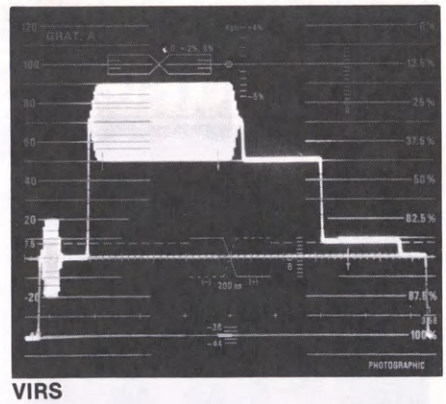
A slow gen-lock mode is provided for those applications where fast-lock may upset the system. The slow-lock selector is located on the generator card sets.

Genlock or external reference lock mode selection may be remotely controlled. Remote manual phasing of the SPG11 or SPG12 (SPG22) signal to an external source is possible in the internal mode. Vertical and/or horizontal timing are altered as in slow lock operation.

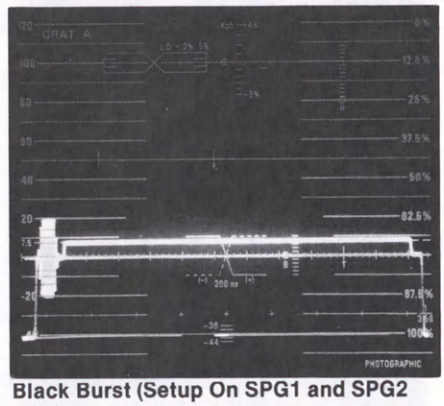
Front panel LED's are used to indicate generator lock status.

Internal adjustments permit some variation of burst and blanking widths on the burst flag, comp blanking, and black burst outputs. These adjustments are preset to conform to recognized standards. You can reduce widths initally to allow for the widening that sometimes occurs when the video signal is processed.

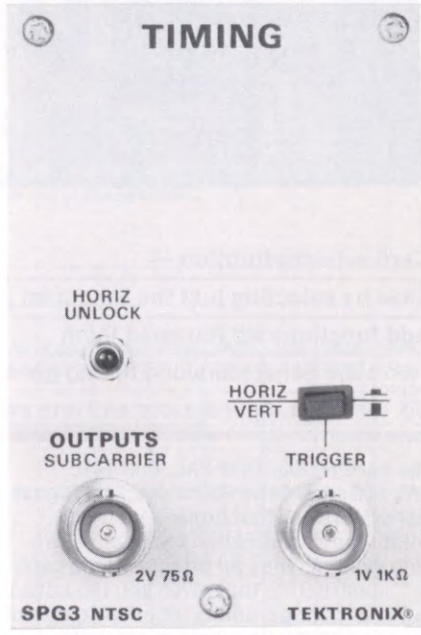
The SPG1 (SPG11) SPG2 (SPG12, 22) provide a black burst output independent of all other outputs. For NTSC systems, the Vertical Interval Reference Signal (VIRS) is factory programmed on line 19, field 1 and 2 of black burst, when selected by a front panel switch on the SPG1 and SPG2. If you require black burst and the VIRS when using the SPG3, add a TSG4 Test Signal Generator. The SPG1 and SPG2 can be internally reprogrammed to provide a full-field VIRS in place of black burst.



VIRS



Black Burst (Setup On SPG1 and SPG2 only)

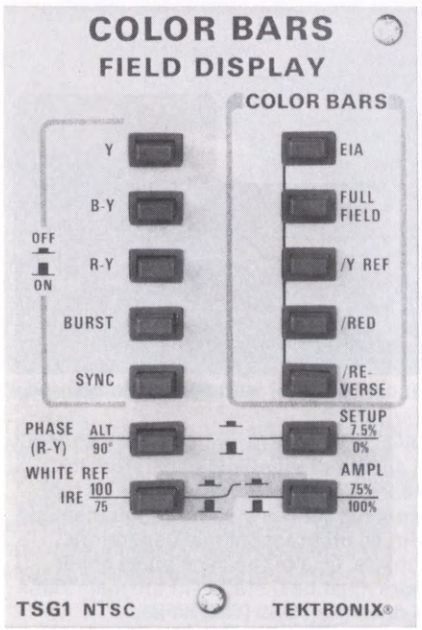


The economical SPG3 (SPG13) is designed for use in test signal generators where sync generator outputs are not required. Generator shown actual size.

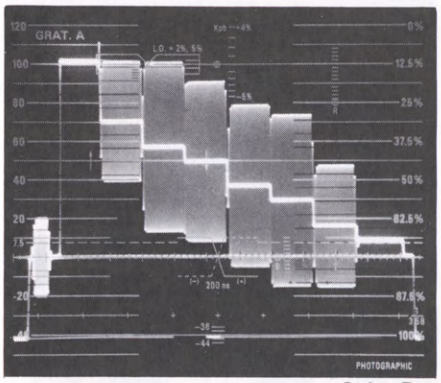
TIMING GENERATORS

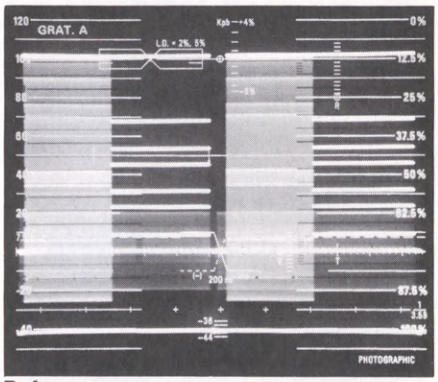
SPG3 (SPG13)

The SPG3 (SPG13) is recommended for economy when a generator is used as a test signal source without sync outputs. This card-set generator provides all the internal sync and timing required to operate test signal generators and provides front-panel subcarrier and oscilloscope triggering outputs. Internal or external subcarrier reference may be selected through the remote connector.

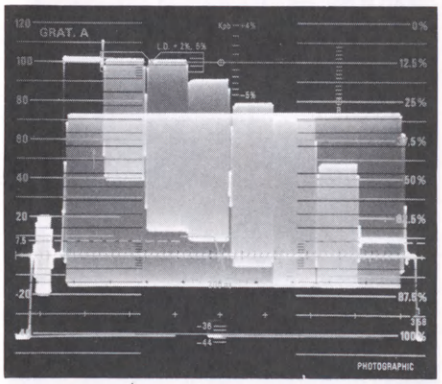


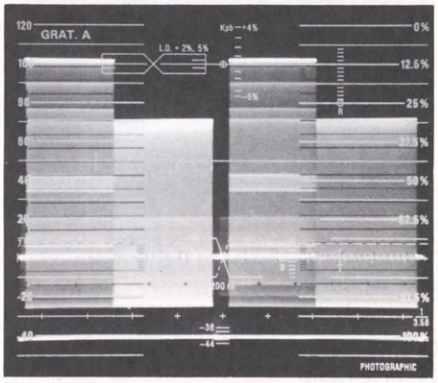
The TSG1 Color Bars Generator. (Actual Size.)



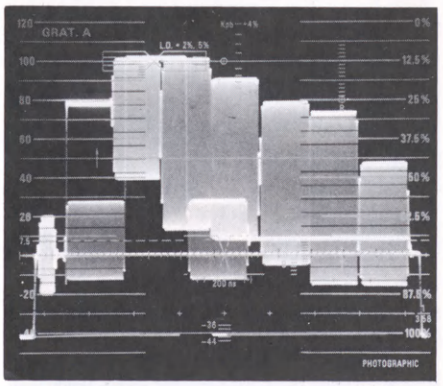


Color Bars/Y Reference

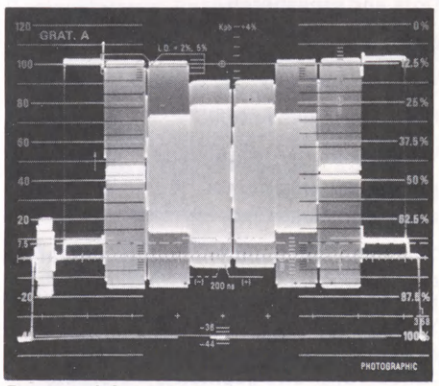




Color Bars/Red Reference



EIA Color Bars



Reversed Color Bars

HIGH QUALITY FULL FIELD/SPLIT FIELD COLOR BARS

TSG1 (TSG11, 21)

Color bars signals

- **EIA (TSG1 only)**
- **Fixed full field (TSG11, 21 only)**
- **Full field with switchable components**
- **75% or 100% amplitude**
- **Split field/Y reference**
- **Split field/Red**
- **Split field bars/bars reversed**

The TSG1, TSG11, and TSG21 provide high-quality full field and split field color bars for the 1410 NTSC, 1411 PAL, and 1412 PAL-M series, respectively. The TSG1 (TSG11, 21) operates independently from any other test signal installed in the mainframe with generator card sets. Its output is available simultaneously with all other test signal outputs. One of the sync pulse generators must be installed in the mainframe to drive the TSG1 (TSG11, 21).

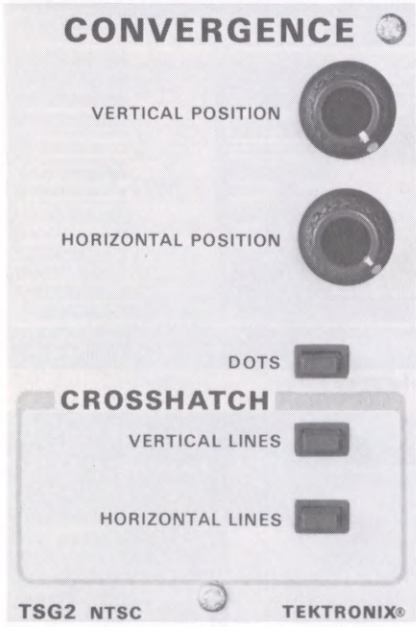
The composition of the TSG1's output signal can be altered by switching off Y, B-Y, R-Y, Burst, and Sync. For the TSG11 (TSG21), this same change is made by switching off Y, U, V, U & V components of Burst, and Sync. You may also select fixed or alternating R-Y (V) subcarrier phase, bar amplitude, white reference, and setup level (or pedestal).

The /Y REF switch selects a split field display of color bars in the same sequence as full field, followed by the luminance portion of the color bars for the remainder of the field. The split can be ½ or ¾ field as selected by internal programming in the sync pulse generator. With this signal, you can check chrominance to luminance delay and picture monitor gray scale tracking while simultaneously evaluating color performance.

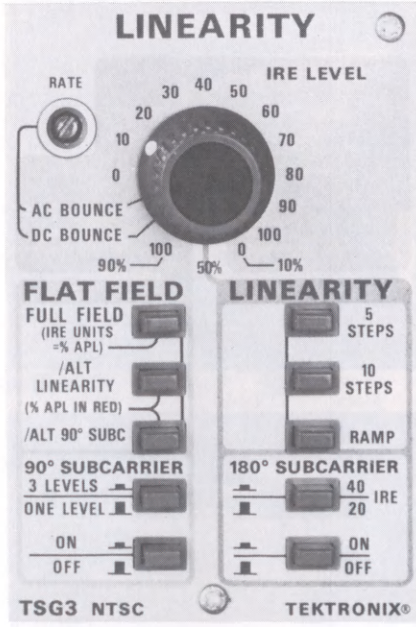
The /RED switch selects a split-field display of color bars, as in /Y REF, followed by red chrominance. (Same phase and amplitude, and at the same luminance level as the red bar.) Use this signal for adjusting VTR playback controls. Head equalization errors and noise are easily spotted on a red field. Other bar colors may be chosen by internal programming. The signal is also remotely switchable to color bars/white (TSG11/21 only).

The /REVERSE switch selects a split field display of color bars as in /Y REF, followed by color bars in a reverse sequence. That is black, blue, red, magenta, green, cyan, yellow, white. This signal helps detect chrominance to luminance delay while viewing the kinescope of a color monitor/receiver. Reverse bars are also useful in detecting VTR velocity errors.

TEST SIGNALS



The TSG2 Convergence Generator. (Actual Size.)



The TSG3 Linearity Generator. (Actual Size.)

CONVERGENCE TEST SIGNALS

TSG2 (TSG12)

- Dots and crosshatch
- Dots only
- Vertical lines only
- Horizontal lines only
- Vertical and horizontal lines
- Position controls

The TSG2 and TSG12 provide high-quality convergence test signals for the 1410 NTSC and 1411 PAL Series respectively. You can use them to determine picture monitor or camera scanning linearity, aspect ratio, and geometric distortion. Signals for the TSG2 conform to IEEE Standard 202.

Provision is made in the TSG2 and TSG12 for on/off switching of the dots, vertical lines, and/or horizontal lines and for positioning vertical and horizontal lines. The signal output is located on the rear panel of the mainframe in which the test signal generator is installed. The convergence signal output is available simultaneously with all other test signal generator outputs.

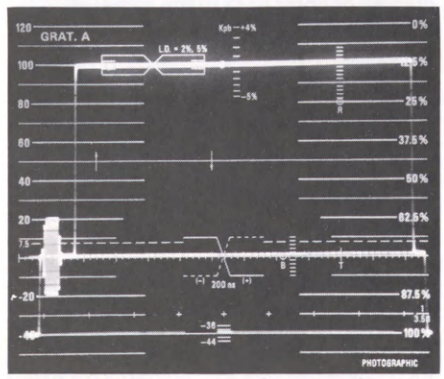
A sync pulse generator must be installed in the mainframe for TSG2 and TSG12 operation.

LINEARITY AND MODULATED PEDESTAL TESTS

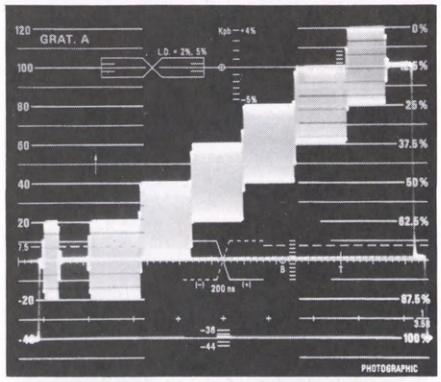
TSG3 (TSG13, 23)

- Staircase
  - 5 step
  - 10 step
  - Ramp
  - 2 modulation amplitudes
- Modulated pedestal
  - One level
  - Three levels
- Flat field
  - 11 fixed levels
- Ac and dc bounce

The TSG3 (TSG13, 23) provide high-quality linearity and modulated pedestal test signals for the 1410 NTSC, 1411 PAL, and 1412 PAL-M, respectively. Combine variable APL with either of these signals to measure nonlinear distortions. The



Flat Field Signal



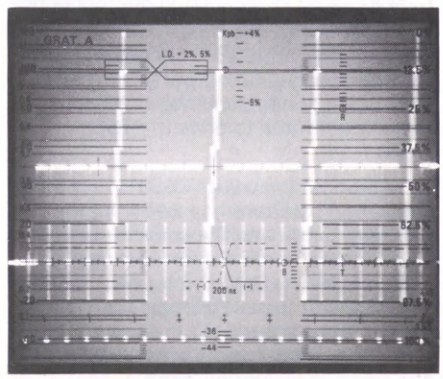
Linearity Signal with 40 IRE Modulation

TSG3 (TSG13, 23) operates independently of all other test signal generators installed in the mainframe, while its rear panel output is available simultaneously with all other test signal generators' outputs. One of the sync pulse generators must be installed in the mainframe to drive the TSG3 (TSG13, 23).

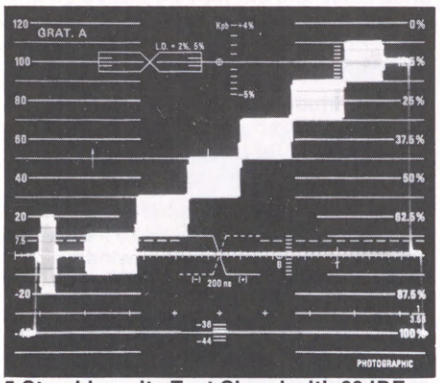
You can select the 5 step and 10 step staircase signals and the ramp signal with or without 180° subcarrier modulation for NTSC, or U subcarrier modulation for PAL and PAL-M. The subcarrier amplitude is front panel selectable at 20 IRE or 40 IRE on the TSG3, or at 140 mV and 280 mV on the TSG13 (TSG23). Applications include measuring differential phase and gain, dynamic gain, luminance linearity, and burst phase errors.

With the TSG3, the flat field signal can be used on all active picture lines with levels set by the IRE Level control, or flat field on four lines can be alternated with one line of linearity or modulated pedestal (90° subcarrier). When using the alternate mode, APL is controlled by the IRE level control.

For the TSG13 (TSG23), flat field signal levels are set by the peak white control percentage, and can be used on all active picture lines. Flat field can also be alternated with linearity or modulated pedestal (V subcarrier). When using an alternate mode, APL is controlled by the peak white control percentage.



4 out of 5 Lines Variable APL



5-Step Linearity Test Signal with 20 IRE Subcarrier Modulation

The ac Bounce position of the IRE level switch (TSG3) or the peak white switch (TSG13, 23) percentage provides a signal in which the active portion of each line (excluding sync) changes APL levels at a rate determined by the rate control (1 to 30 second intervals).

For the TSG3, amplitude of the bounce excursions is fixed at 0 to 100 IRE in flat field mode and 10% to 90% APL in alternate modes. For the TSG13 (TSG23), the lower excursion is continuously adjustable between 0 and 15% and the upper excursion between 85 and 100%. Blanking level remains fixed at 0 V. To check ac coupled circuitry use ac bounce.

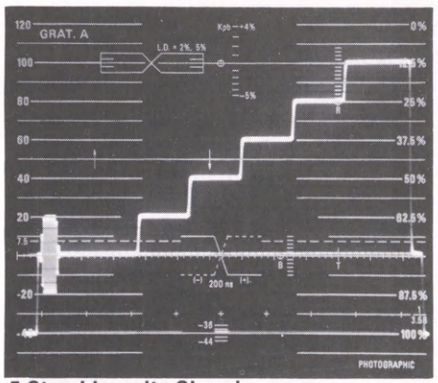
With the switch set to dc bounce, ac bounce occurs as described above. In addition, the entire signal changes dc level in the opposite direction at the same rate resulting in no change in average dc level. Line rate, field rate or frame rate bounce may be selected by internal plug-jumper. Clamp circuits may be checked using dc bounce.

The modulated pedestal, a unique, Tektronix-developed chroma-step signal, facilitates measurement of luminance signal distortion caused by the subcarrier signal (chrominance-luminance intermodulation), and chrominance nonlinear gain and phase distortions.

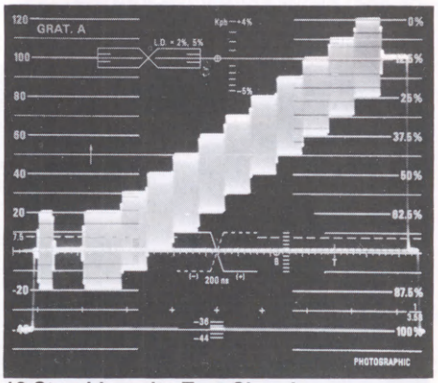
Selection of the modulated pedestal adds subcarrier, phased to lead burst by 90° (by 45° of the + V component in the TSG13, 23), to the variable amplitude pedestal.

For the TSG3, either one level of 5 to 20 IRE subcarrier or three levels of 20, 40, and 80 IRE subcarrier can be selected.

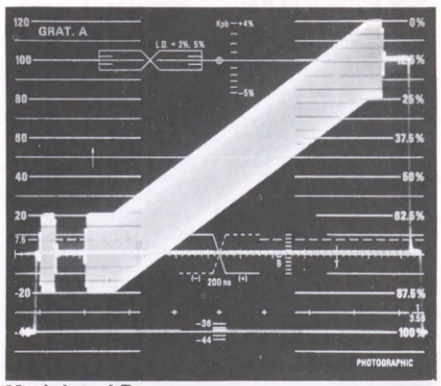
The TSG13 (TSG23) subcarrier may be selected at either one level of 34 mV to 140 mV subcarrier or as three levels of 140 mV, 280 mV, and 700 mV.



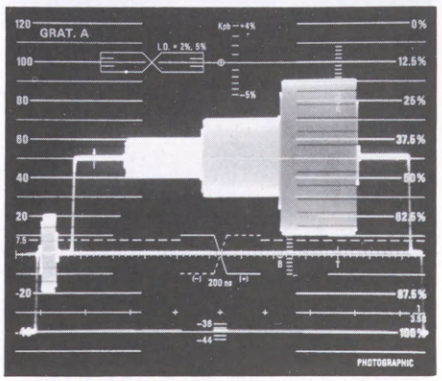
5-Step Linearity Signal



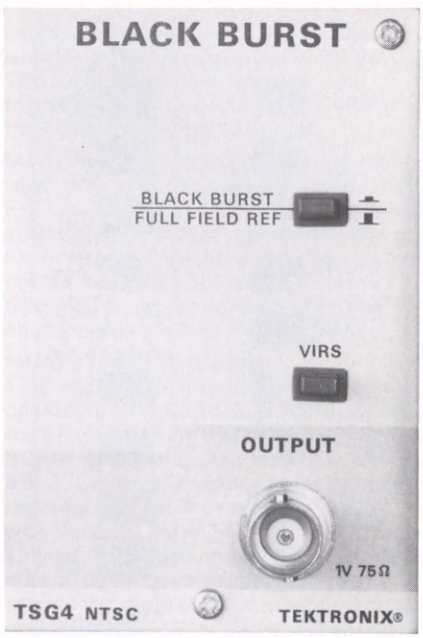
10-Step Linearity Test Signal



Modulated Ramp



Modulated Pedestal



The TSG4 (actual size) is normally used only with SPG3.

BLACK BURST

TSG4 (TSG14)

Black burst

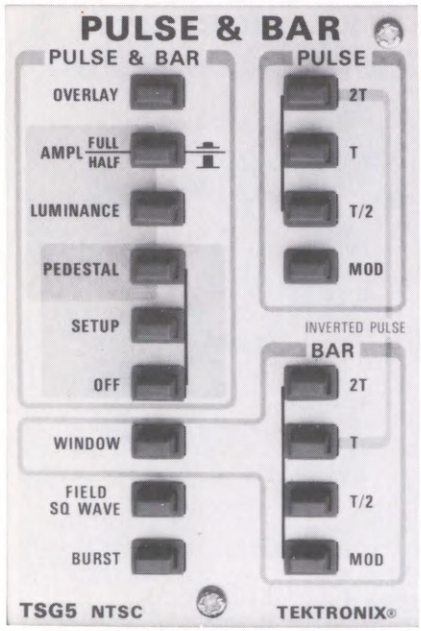
Vertical Interval Reference Signal (TSG4 only)

The TSG4 and TSG14 Black Burst Generators are designed for use with the SPG3 and SPG13 Timing Generators, respectively. These are the only sync generators that do not generate black burst.

The TSG4 may also be used to generate a full field Vertical Interval Reference Signal for NTSC. Because of the VIR signal's simplicity, you may consider it a substitute for color bars on video tape leaders and use VIRS to adjust VTR playback conditions.

The TSG4 (TSG14) may be used with SPG1 (SPG11) and SPG2 (SPG12) as a second source of black burst.

TEST SIGNALS



PULSE AND BAR GENERATORS

TSG5 (TSG15)

Pulse and bar overlay

Full or half amplitude pulse and bar

Field square wave and window

Modulated pulse and modulated bar

Front panel selection of 2T, T, and T/2 pulse width and bar rise time

The TSG5 and TSG15 are sin² pulse and bar television test signal generators designed for use with the 1410 NTSC and 1411 PAL mainframes, respectively. They're well suited for testing on equipment manufacturers' production lines and for testing of television transmitters, common carrier microwave and wire lines, and studio distribution systems. Front panel controls provide most test signal options, while internally selectable options provide additional versatility.

The pulse and bar test signal consists of a sin² modulated pulse, a sin² pulse, and luminance bar. The pulse and bar overlay mode lets you conveniently compare pulse to bar ratio without manipulating waveform monitor controls.

The inverted and non-inverted 2T pulses may be overlaid to compare shape and half amplitude duration (HAD). This capablility is particularly useful in detecting quadrature distortion which results from envelope detection of the RF modulated video signal. The pulse and bar test signal is also useful in measuring line time and short time distortions.

For sin² pulse signals, three self-cancelling switches permit independent selection of pulse half amplitude duration (2T, T, T/2) independent of bar rise time. An internal jumper option lets you add an inverted 2T pulse to the T bar whenever the non-inverted 2T pulse is selected. Another internal jumper lets you select 12.5T or 20T HAD modulated pulses on the TSG5, and 10T or 20T HAD modulated pulses in the TSG15.

In the bar mode, four self-cancelling switches permit selection of luminance bar rise time (2T, T, T/2) or modulated bar. For the TSG5, the modulated bar rise time is 1507 ns when using a 12.5T modulated pulse, or 2411 ns for a 20T pulse. For the TSG15, modulated bar rise time is 964 ns when using a 10T modulated pulse, or 1929 ns for a 20T pulse.

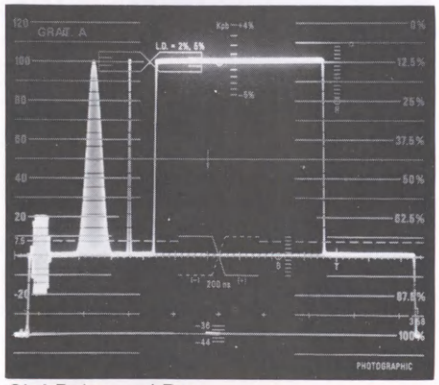
Full or half amplitude pulse and bar test signals can be provided with or without pedestal or setup (the TSG15 does not offer setup capability). For the TSG5, full amplitude is 100 IRE units with no setup. Half amplitude is 50 IRE with no setup. The 7.5% (IRE) setup reduces pulse and bar amplitude appropriately: 92.5 IRE plus 7.5 IRE at full amplitude, 46.25 IRE plus 7.5 IRE at half amplitude. For the TSG15, full amplitude is 100% (700 mV) with no setup. Half amplitude is 50% (350 mV) with no setup.

The luminance pulse, luminance bar, and luminance components of the modulated pulse and modulated bar may be switched off to provide chrominance pulse and chrominance bar. The chrominance pulse and bar may be placed on a pedestal (50 IRE for the TSG5, 50% for the TSG15) to prevent chrominance from extending below blanking level.

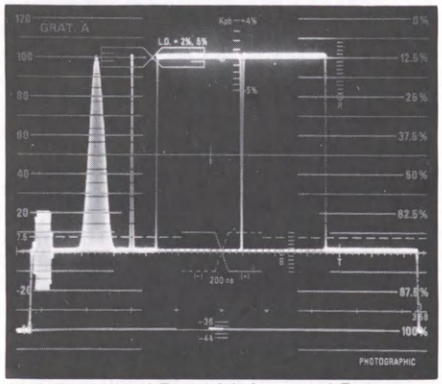
Full amplitude luminance reduces the pedestal. The reduced pedestal (0 IRE for the TSG5, 0% for the TSG15) is internally adjustable from zero to 25 IRE.

Use the standard field square wave (with full amplitude and no setup) to measure field time distortion, and the window signal to measure line time distortion and picture monitor smearing. You can switch the color burst off without affecting the chrominance components of the test signals.

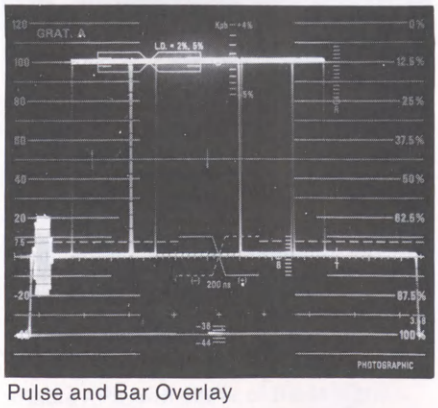
Use the TSG5 (and TSG15) for measuring overall gain, transient response, line and field time tilt, and chrominance to luminance delay and gain.



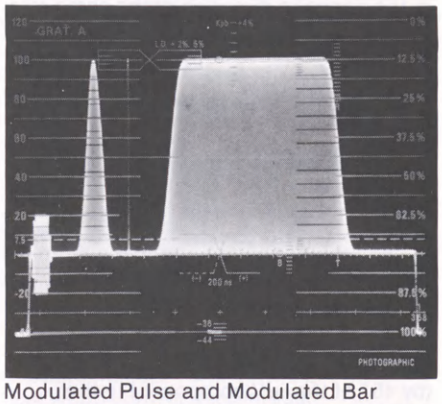
Sin² Pulse and Bar



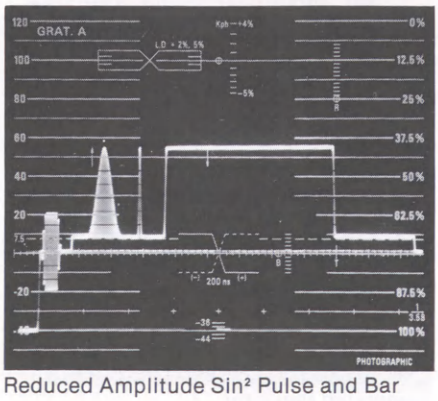
Sin² Pulse and Bar with Inverted Pulse



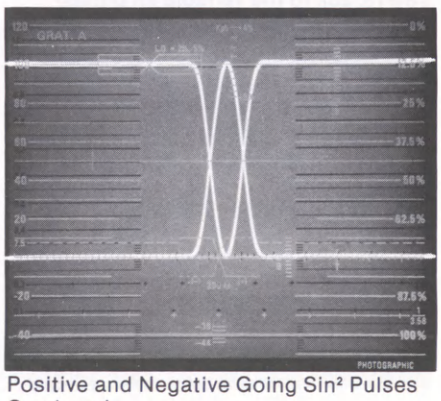
Pulse and Bar Overlay



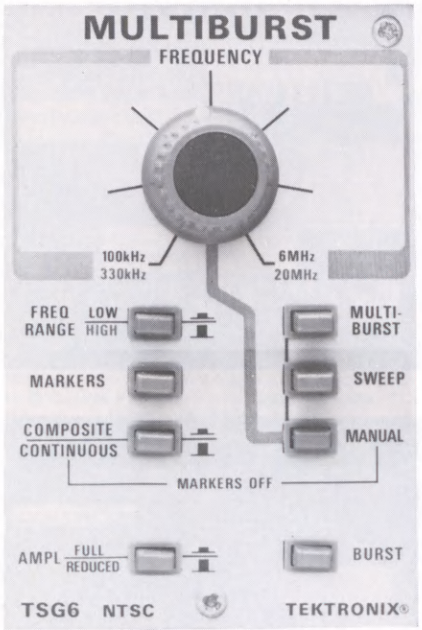
Modulated Pulse and Modulated Bar



Reduced Amplitude Sin² Pulse and Bar



Positive and Negative Going Sin² Pulses Overlayed



MULTIBURST SIGNAL

TSG6 (TSG16)

Multiburst signal

Controlled rise time bursts

Last burst frequency variable

Manual and field swept frequency signals to 20 MHz

Markers for both frequency and amplitude reference

Full and reduced amplitude on all signals

The TSG6 and TSG16 are television multiburst and video sweep test signal generators designed for the 1410 NTSC and 1411 PAL mainframes, respectively. They feature front-panel controls for most test signal options, plus special Remote functions for additional versatility. The TSG6 and TSG16 can be used in many testing applications, including equipment manufacture, and microwave or long-line transmission systems.

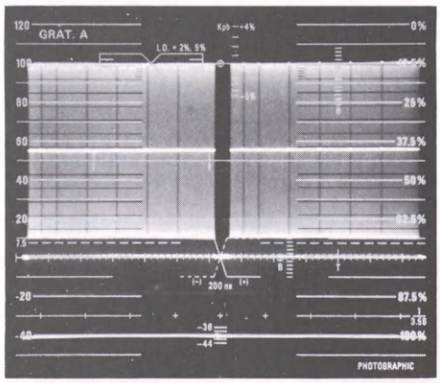
Design advances help make multiburst, the signal most often used for testing mid-and upper-frequency responses of television systems, easier to use and more effective in these new generators. Performance advances include reduction in harmonic content of sine wave signals and skirt energy associated with gating burst packets. Phase modulation of the burst packets aids ease of measurement by filling in shape of packets. Two ranges of multiburst frequencies are available: the 500 kHz to 4.1 MHz (TSG6) range aids in testing television transmitters and common carrier links, while the 1.25 MHz to 12 MHz range is used in testing television studio equipment and cabling.

Use these new generators where nonlinearities make reduced amplitude test signals desirable. The reduced amplitude multiburst signal allows accurate testing of vidoe tape record/playback systems, since it is not subject to the false distortion of the full amplitude multiburst that often occurs in such applications.

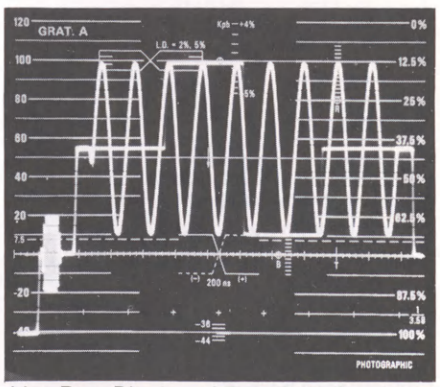
Using the front panel controls, you can select a high- or low-frequency band for each operating mode: SWEEP, MANUAL, or MULTIBURST. SWEEP allows selection of field sweep signal with or without markers. MARKERS inserts amplitude/frequency markers in SWEEP, where frequencies are occurring in sweep, and amplitude markers in COMPOSITE/MANUAL. BURST allows insertion/deletion of color burst on composite video for use with systems that operate differently when burst is present. COMPOSITE/CONTINUOUS determines whether sync, blanking, and a pedestal will be added to the sweep and manual signals.

MANUAL selects a fixed-frequency sine wave with frequency determined by the FREQUENCY control and FREQ RANGE switch. AMPL allows selection of either full or reduced amplitude in all operating modes. MULTIBURST selects line rate discrete frequency packets with reference insertion levels.

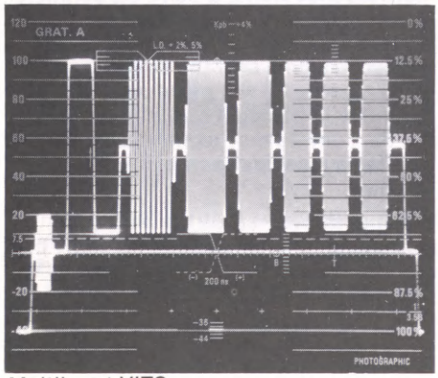
Remote fuctions, accessible through the 1410 and 1411 Mainframes, enhance the capabilities of the TSG6 (TSG16). When the generator is operating in the MULTIBURST mode and LAST BURST VARIABLE is remotely enabled, you can adjust the frequency of the last burst packet with the front panel FREQUENCY control. This adjustment range is less than that of normal operation for increased resolution around the band-edge of most broadcast and transmission facilities. Activating the CALIBRATE remote will change the multiburst to a continuous sine wave with the frequency of the last burst packet. This capability, coupled with a frequence counter, provides a means of making highly accurate frequency response measurements.



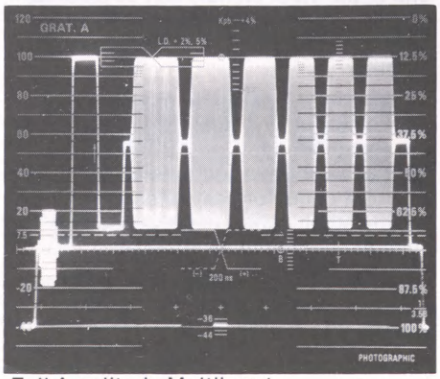
Field Rate Sweep



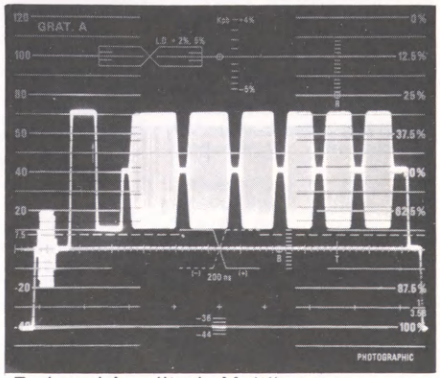
Line Rate Display of Field Rate Sweep Showing Frequency and Amplitude Marker



Multiburst VITS

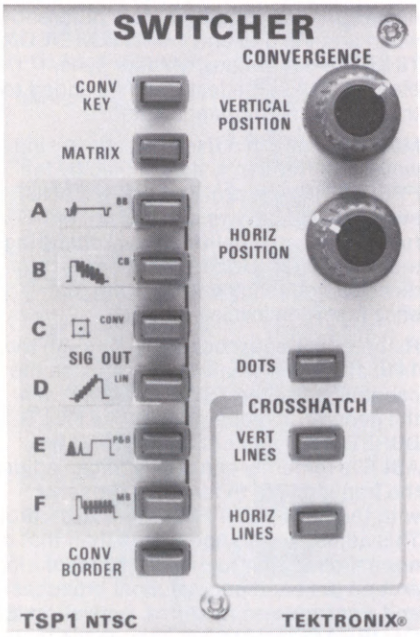


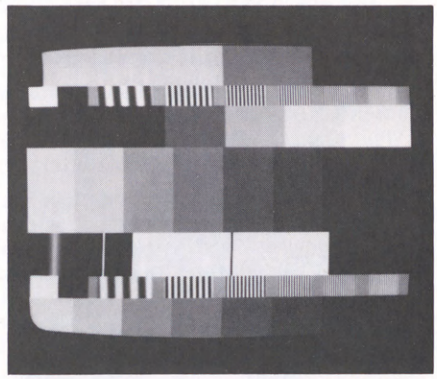
Full Amplitude Multiburst

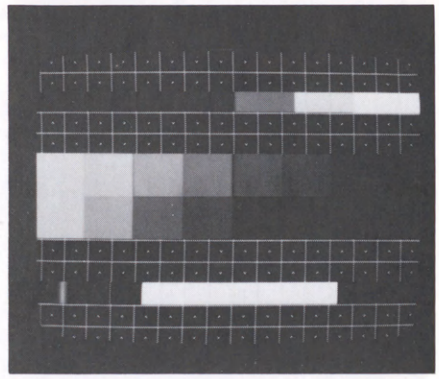


Reduced Amplitude Multiburst

TEST SIGNALS







SWITCHER

TSP1 (TSP11, TSP21)

Single, switchable ouput for two to six generated signals

Blanking, sync and burst insertion for external signal

Matrixing — eight programmed display formats of up to six sequential signals

Convergence border

Convergence key

CONVERGENCE GENERATOR

Crosshatch

Dots

Combined crosshatch/dots

The TSP1, TSP11, and TSP21 combine the capabilities of a test signal switcher and convergence signal generator in a single unit. They simplify and expand the uses of the 1410 NTSC, 1411 PAL and 1412 PAL-M Series Generators, respectively.

From a single, electronically switched output, you have access to all the test signals (from two to six) generated by the card sets in the mainframe. Meanwhile, you may continue to use the individual generator card sets' parallel outputs, so no restrictions are imposed on an established system. As an added feature, one of the input signals can be external (composite or noncomposite). All of the switcher inputs are provided with clamp circuitry.

Select any one of the input signals for full field display using pushbuttons A to F on the switcher panel. Inputs may be configured as desired and then identified on the front panel for easy reference by using the small adhesive-backed labels supplied with each switcher unit.

Eight different matrixes are stored in the PROM. This signal matrixing capability, combined with the full-field mode of the TSP1 (TSP11, TSP21) presents several combinations of signals sharing the full field display. A single glance lets you evaluate several performance parameters at once, saving time and simplifying system and equipment setup.

When you want to include other signals along with convergence signal, the CONVERGENCE functions of the TSP1 (TSP11, TSP21) simplify the job. Engage the CONV BORDER key to display the convergence signal around the perimeter and in the center of the picture display. Or use the CONV KEY to key in the convergence signal over the selected signal. Although the convergence board operates in conjunction with the switcher, the convergence signal is also available independently of switcher output.

Most of the TSP1 (TSP11, TSP21) switching functions can be remotely controlled through the 1410, 1411, and 1412 Mainframe's REMOTE connector J41.

1410

Subcarrier Frequency — 3.579545 MHz ±10 Hz. Option 01: 3.579545 MHz ±1 Hz.

Pull-in Range — Fsc ±50 Hz. Option 01: fsc ±20 Hz.

Subcarrier Input Requirements — Amplitude 1.0 V to 4.0 V p-p. Frequency: 3.579545 MHz ±10 Hz.

Subcarrier Return Loss — ≥ −46 dB to 3.579545 MHz.

Mechanical Specifications — Length: 19.2 in. (48.77 cm). Width: 19.0 in. (48.26 cm). Height: 3.47 in. (8.81 cm).

Mains Voltage Ranges — 90-112 V ac. 106-132 V ac, 180-224 V ac and 212-250 V ac. Factory set at 106-132 V ac.

Crest Factor — ≥1.35.

Power Consumption — 130 W. max.

Max Amps — At 120 V ac, 60 Hz — 1.2A.

Mains Frequency — 50-60 Hz.

GEN-LOCK (SPG2 ONLY)

Input Configuration — 75 Ω loop-through with return loss ≥ −46 dB to 5 MHz.

Input Requirements — 1 V nominal composite video or black burst, sync negative. Sync amplitude: 286 mV ±6 dB. Burst amplitude: 286 mV ±12 dB. Burst sync ratio: within 6 dB.

Subcarrier Phase Error With Frequency Change — Within 0.5° with input burst frequency change of ±10 Hz. (Subcarrier Phase Error with Burst Amplitude Change) — ±1° 210 mV to 420 mV, ±3° 75 mV to 1.2 V.

Subcarrier Phase Stability — 0.2° for burst timing errors including burst width variance (8 to 10 cycles) and breezeway variance (±0.28 μs). Within ≤0.1° with APL change from 10% to 90%. Within 1° with RMS white noise at 24 dB below nominal p-p picture signal (nominal) 714 mV.

Subcarrier Phase Range — 360° via front-panel goniometer.

Line Sync Delay Range — Adjustable to advance output sync ≥10 μs or delay ≥4 μs (internal adjustment). A front panel screwdriver adjustment provides a delay/advance range of ±0.5 μs.

Stability (over ambient temperature range 0 °C to 50 °C) — Line lock: within 70 ns. Subcarrier lock: within 35 ns.

Jitter — Line lock: ≤10 ns. Subcarrier lock: ≤4 ns.

Field/frame Sync — Fast lock: direct-acting in 1 field. Slow lock: 1 line/field slew.

EXTERNAL REFERENCE (SPG1 AND SPG2)

Input Configuration — 75 Ω loop-through with Return Loss ≥ — 46 dB to 5 MHz.

Subcarrier Input Requirements — Amplitude: 1.0 V to 4.0 V p-p. Frequency: 3.579545 MHz ±10 Hz. Return loss: ≥ −46 dB to 3.579545 MHz.

Comp Sync Input Requirments — Amplitude: 2.0 V to 8.0 V p-p. Polarity: negative.

Loss of Lock — Indicated by front-panel LED indicators. Automatic switching to partial or full internal reference.

Subcarrier Stability — Output follows input.

Line Sync Delay Range — Adjustable to advance output sync ≥10 μs or delay ≥4 μs (internal adjustment). A front panel screwdriver adjustment provides a delay/advance range of ±0.5 μs.

Subcarrier Phase Range — 360° via front-panel goniometer.

OUTPUTS (SPG1 AND SPG2)

Subcarrier — Amplitude: 2 V p-p into 75 Ω. Return loss: ≥30 dB to 5 MHz.

Composite Sync — Equalizing pulse duration: 2.38 μs ±50 ns; sequence duration: 3 lines. Field Sync — duration 27.0 μs ±200 ns; duration 3 lines; interval between field sync pulses; 4.7 μs ±100 ns. Jitter: ≤4 ns. Line sync duration: 4.7 μs ±100 ns. Return loss: ≥ −30 dB to 5 MHz. Isolation: ≥ −30 dB. Output level into 75 Ω: 4 V ±5%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

Comp Blanking — Line blanking duration: 10.7 μs nominal, adjustable 9 to 12 μs. Field blanking duration: 20 lines nominal, adjustable 16 to 21 lines. Output level into 75 Ω: 4 V ±5%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

Burst Flag — Delay from line sync: adjustable. Duration: 2.51 μs ±50 ns (9 cycles of subcarrier, adjustable).

Line Drive — Duration: start of line blanking to end of line sync ±100 ns. Output level into 75 Ω: 4 V ±5%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

Field Drive — Duration: 9 lines. Output level into 75 Ω: 4 V ±5%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

Field Ref — Position: Field 1, line 11 or Field 3, line 10. (internally selectable).

VIR Signal — Chrominance: amplitude 286 mV ±2.85 mV (40 IRE ±0.4 IRE); phase within 0.5° of burst; envelope rise time Sin² shaped, 1 μs ±150 ns. Luminance: setup level 53.57 mV ±3.57 mV (7.5 IRE ±0.5 IRE); gray level 357 mV ±3.57 mV (50 IRE ±0.5 IRE); chroma pedestal 500 mV ±5 mV (70 IRE ±0.7 IRE); rise and fall time Sin² shaped, 250 ns ±39 ns.

Black Burst — Amplitude: sync 286 mV ±3.57 mV (40 IRE ±0.5 IRE) negative-going; setup 53.57 mV ±3.57 mV (7.5 IRE ±0.5 IRE); burst 286 mV ±2.86 mV (40 IRE ±0.4 IRE).

Burst — HAD of envelope: 2.51 μs ±35 ns. Rise and fall time: 400 ns ±60 ns.

Breezeway — 475 ns ±50 ns at 10% point.

Setup — Start adjustable 9.58 μs from leading edge of line sync, stop 1.59 μs before next line sync leading edge.

COMPOSITE VIDEO OUTPUT

Total Amplitude — 1 V into 75 Ω.

Sync Amplitude — −285 mV. ±2.86 mV.

Peak Level Amplitude — 714.3 mV ±7.14 mV.

Blanking DC Level — 0V ±50 mV.

Return Loss — ≥ −30 dB.

Isolation — ≥ −40 dB.

Field Period — 16.68 ms.

Line Period — 63.56 μs.

Rise and Fall Time — 130 ns, +20, −10 ns.

Front Porch Duration — 1.59 μs ±50 ns at 50% point, 1.52 μs at 10% point.

Line Blanking Interval — 11.1 μs.

Breezeway — −475 ns ±50 ns at 10% point.

Burst — Rise and Fall Time: 400 ns ±60 ns. Delay from Line Sync: 5.309 μs (19 cycles of subcarrier) ±35 ns. HAD of Envelope: 2.51 μs (9 cycles of subcarrier) ±70 ns. Amplitude: 285.7 mV ±8.75 mV. Phase 180°.

TSG1

Luminance Signal Accuracy — Within 1% or 1.5 mV, whichever is greater.

Chrominance Accuracy — Absolute Amplitudes: within 3% (all subcarrier components). Relative Amplitudes: within 1% of the red chrominance bars or 1 mV plus p-p residual subcarrier amplitude, whichever is greater.

Full Field Displays — Bar width: 6.45 μs. White bar rise time: 130 ns, +20, −10 ns. Time difference between chroma and lum channels: ≤20 ns.

SPLIT FIELD DISPLAYS

Color Bars/Y-Ref — (Selected by plug-jumper on Sync Timing board in SPG.) Color bars: ½ or ¾ field, selectable. Ref: ½ or ¼ field, selectable.

Color Bars/Red — (Selected by plug-jumper, on Sync Timing board in the SPG.) Color bars: ½ or ¾ field, selectable. Red: ½ or ¼ field, selectable.

Color Bars/Reverse — (Selected by plug-jumper on Sync Timing board in SPG.) Color bars: ½ or ¾ field, selectable. Reverse sequence: ½ or ¼ field, selectable.

TSG2

Displays Available — Crosshatch, vertical lines only, horizontal lines only, dots only, and crosshatch plus dots (dots appear centered in the rectangles formed by the crosshatch pattern). Horizontal and vertical positioning.

Convergence Pattern — Setup: 7.5 IRE ±1. Sync amplitude: 40 IRE ±2. Peak level: 77 IRE ±3. Rise and fall time 135 ns ±15.

TSG3

Luminance Component — Peak amplitude: 714 mV ±7.14 mV. 5 Step amplitude: 143 mV. 10 Step amplitude: 71.5 mV. Aberrations: within 2% of step amplitude. Step rise time: 250 ns ±39 ns between steps within 1%.

180° Subcarrier Component — Absolute amplitudes: ±3%. Relative amplitudes: ±1%. 20 IRE: 143 mV ±3%. 40 IRE: 285.7 mV ±3%.

Subcarrier Envelope — Rise time: 400 ns ±60 ns. Duration: 47.7 μs. Delay from Line Sync: 9.93 μs.

Differential Phase — 0.1° or loss at 10%, 50%, and 90% APL.

Differential Gain — 0.5% or less at 10%, 50% and 90% APL.

CHARACTERISTICS

Modulated Pedestal — 90° Subcarrier. Amplitude.

1 Level — 5 to 20 IRE (internally adjustable).

3 Levels — 20, 40, and 80 IRE.

TSG4

VIR SIGNAL

Chrominance — Amplitude: 286 mV ±2.86 mV (40 IRE ±0.4 IRE). Phase: within 0.5° of burst. Envelope rise time: Sin² shaped, 1 μs ±150 ns.

Luminance — Setup level: (7.5 IRE ±0.5 IRE). Gray level: (50 IRE ±0.5 IRE). Chroma pedestal: (70 IRE ±0.7 IRE).

BLACK BURST

Sync Amplitude — 40 IRE ±0.5 IRE.

Rise and Fall Time — 130 ns, +20, −10 ns.

Setup Level — (7.5 IRE ±0.5 IRE).

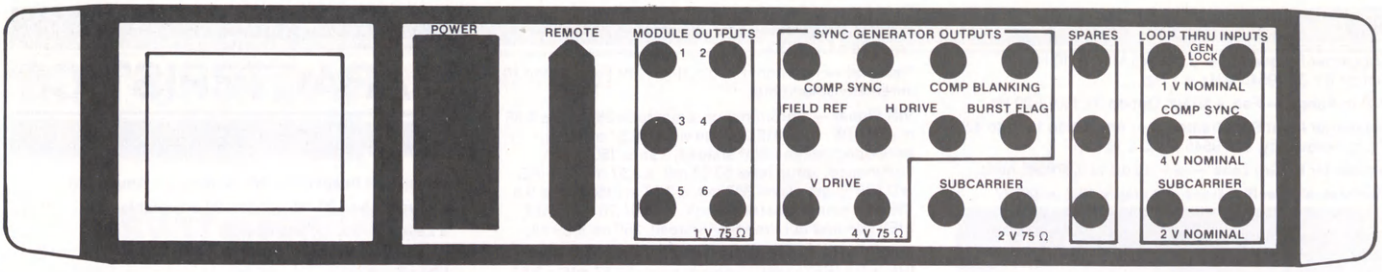
Burst — (40 IRE ±0.4 IRE).

Burst — Rise time 400 ns ±60 ns.

TSG5

	Full Amplitude	Half Amplitude
Luminance Bar Amplitude		
Setup Off	714.3 mV ±7.1 mV	3.57.1 mV ±3.6 mV
Modulated Bar Amplitude		
Setup Off		
Luminance	357.1 mV ±3.6 mV	178.6 mV ±1.8 mV
P-P Chrominance	714.3 mV ±14.3 mV	357.1 mV ±7.1 mV
Pulse Amplitude		
Setup Off		
2T	714.3 mV ±7.1 mV	357.1 mV ±5.4 mV
−2T	714.3 mV ±10.7 mV	357.1 mV ±7.1 mV
T	714.3 mV ±10.7 mV	357.1 mV ±7.1 mV
T/2	714.3 mV ±14.3 mV	347.1 mV ±14.3 mV
Modulated	714.3 mV ±7.1 mV	357.1 mV ±5.4 mV
Pulse to Bar Ratio		
2T	1:1 ±0.005	1:1 ±0.01
−2T	1:1 ±0.01	1:1 ±0.02
T	1:1 ±0.01	1:1 ±0.02
T/2	1:1 ±0.02	1:1 ±0.04
Modulated Pulse to Modulated Bar	1:1 ±0.01	1:1 ±0.02
Modulated Pulse and Bar		
Chrominance-Luminance Gain	3.6 mV maximum amplitude difference of peak chrominance and peak luminance.	
Delay	5.0 ns maximum	
Residual Subcarrier	2.0 mV maximum.	
Other Baseline Errors	3.6 mV maximum.	
Subcarrier Phase Factory Set	Phase Modulated 360° at field rate	
Optional Subcarrier	Fixed phase	
Harmonics	At least 40 dB down.	

	Half Amplitude Duration (HAD)	Overshoot
Luminance Pulse		
2T	250 ns ±5%	0.5%
T	125 ns ±5%	1.0%
T/2	62.5 ns ±10%	2.0%
Modulated Pulse		
12.5T	1562.5 ns ±5%	1.0%
20T	2500 ns ±5%	1.0%



	Risetime	Overshoot
Bar		
Detail		
2T	241.1 ns ± 10%	0.5%
T	120.5 ns ± 10%	1.0%
T/2	60.3 ns ± 15%	2.0%
12.5T Modulated	1506.8 ns ± 10%	1.0%
20T Modulated	2410.9 ns ± 10%	1.0%
Line Tilt	0.5% maximum	
Window		
Line Timing	Bar Timing	
Field Timing	White lines from line 67 to line 218 each field.	
Field Tilt	0.5% maximum	
Field Squarewave		
Amplitude	714.3 mV ± 14.3 mV.	
Field Timing	White lines 75 to 206 each field.	
Field Tilt	0.5% maximum.	
Setup		
Amplitude	53.6 mV ± 1.6 mV (7.5% or 7.5 IRE).	
Risetime	130 ns + 20 ns − 10 ns.	
Timing	From 1410 mainframe Horizontal and Vertical Blanking.	
Pedestal		
Amplitude		
Luminance Off or Half Amplitude	357.1 mV ± 7.1 mV (50 IRE).	
Luminance On and Full Amplitude		
Factory Set Internal Option	Pedestal Off	
	71.4 mV to 178.6 mV adjustable.	
Timing	From 1410 mainframe Horizontal and Vertical Blanking.	
Risetime	130 ns + .20 ns − 10 ns.	

TSG6

	Low Range	High Range
Multiburst		
Frequencies	500 kHz ± 3%	1.25 MHz ± 3%
	1.25 MHz ± 3%	3.50 MHz ± 3%
	2.00 MHz ± 3%	5.50 MHz ± 3%
	3.00 MHz ± 3%	8.00 MHz ± 3%
	3.58 MHz ± 3%	10.0 MHz ± 3%
	4.10 MHz ± 3%	12.0 MHz ± 3%
Amplitude (First Multiburst Packet)		
Full	643 mV (90 IRE) ± 20 mV	643 mV ± 25 mV
Reduced	428 mV (60 IRE) ± 12 mV	428 mV ± 16 mV
Flatness		
Full	10 mV or less	16 mV or less
Reduced	10 mV or less	16 mV or less
Packet Envelope Risetime	400 ns ± 60 ns	400 ns ± 60 ns
Burst Phasing	Phase shifted at field rate to provide filled-in burst packets.	
Sweep/Manual		
Sine Wave Frequencies		
Start	100 kHz minimum	330 kHz minimum
Stop	6 MHz ± 10%	20 MHz ± 10%
Amplitude at First Marker Full	643 mV ± 20 mV	643 mV ± 25 mV
Reduced	428 mV ± 12 mV	428 mV ± 16 mV
Flatness***		
Full	10 mV	15 mV to 12 MHz 20 mV to 20 MHz
Reduced	10 mV	15 mV to 12 MHz 20 mV to 20 MHz

	Low Range	High Range
Markers		
Frequencies	500 kHz ± 3%*	1.0 MHz ± 3%*
	1.0 MHz ± 3%*	2.0 MHz ± 3%*
	2.0 MHz ± 3%*	4.0 MHz ± 3%*
	3.0 MHz ± 3%*	6.0 MHz ± 3%*
	4.0 MHz ± 3%*	8.0 MHz ± 3%*
	5.0 MHz ± 3%*	10.0 MHz ± 4%*
		12.0 MHz ± 4%**
		14.0 MHz ± 6%**
		16.0 MHz ± 7%**
		18.0 MHz ± 7%**
		20.0 MHz ± 7%**
Multiburst/Manual Last Burst Variable Mode)		
Frequency Range		
Start	< 3.8 MHz	< 14 MHz
Stop	> 4.5 MHz	20 MHz ± 10%
Accuracy	± 0.2% short term	± 1% short term
Amplitude (Markers & Pedestal all Modes) Markers Relative to Pedestal Level		
Full	± 321 mV ± 1%	± 321 mV ± 1%
Reduced	± 214 mV ± 1%	± 214 mV ± 1%
Pedestal Level		
Full	393 mV ± 1%	393 mV ± 1%
Reduced	286 mV ± 1%	286 mV ± 1%
Risetime	250 ns ± 50 ns	250 ns ± 50 ns
Harmonic Distortion (Single Frequency Relative to Fundamental)	− 44 dB, 300 kHz, to 4.2 MHz	− 38 dB, 330 kHz, to 6.0 MHz
	− 40 dB, 100 kHz, to 300 kHz − 40 dB, 4.2 MHz to 6.0 MHz	− 36 dB, above 6 MHz to 20 MHz

*Within one television line either side of the marker.
**Above 10 MHz, difference frequency between markers in 2 MHz ± 400 kHz.
***Max-min diode detected peak to peak voltages.

TSP1

SWITCHER

Input Signal —
Amplitude Limits: 1.4 V p-p.
Input Return Loss: ≥ 30 dB, to 5 MHz.
Input Isolation: ≥ 50 dB, internal inputs.
Input Impedance: 75 Ω.

Switcher Output Signal —
Timing: Same as inputs, delayed by approximately 10 ns (10-20° of subcarrier).
Amplitudes: Within 2% of inputs.
Blanking dc Level: 0 V ± 100 mV.
Relative Blanking Level: Within 15 mV, between signals.
Added Distortion:
Noise: < 60 dB, to 5 MHz.
Residual Subcarrier: < 1 mV.
Differential Gain: < 0.5%.
Differential Phase: < 0.3°.
Luminance Linearity: 1%.
Pulse to Bar Ratio: 2T: 1:1 ± 0.5%.
Tilt: < 1%, line or field.
Flatness: 1% to 5 MHz.
2% to 10 MHz.
4% to 20 MHz.
Clamping:
Aberrations: < 10 mV, at burst gate time.

Subcarrier Phase with Respect to Inserted (Channel B) Burst at Full Field Mode — Within 5° (system requirement depends on TSG units).

Matrix Timing — Field split into 14 unblanked horizontal strips (max).

Output Return Loss — ≥ 30 dB to 5 MHz.

CONVERGENCE

Convergence Signal
Line and Dot Pulses —
Amplitude: 77 IRE ± 3 IRE (Horizontal Line bar amplitude within 1%).
Rise and Fall Times:
130 ns + 20 ns − 10 ns.
Blanking —
Dc Level: 0 V ± 50 mV.
Timing: Set by SPG.
Front Porch: ≥ 1.52 μs.
Sync —
Amplitude: − 40 IRE ± 2 IRE.
Timing: Set by SPG.
Rise time: 130 ns + 20 ns − 10 ns.
Setup —
Amplitude; 7.5 IRE ± 1 IRE.
Timing: Set by SPG.
Rise time: 130 ns + 20 ns − 10 ns.
Isolation —
≥ 40 dB.
Return Loss —
≥ 30 dB to 5 MHz.

Convergence Pattern	Large Squares	Small Squares	Large Squares	Small Squares
Vertical Lines				
Line-to-Line Duration	6.36 μs	3.18 μs	H/10	H/20
Position Range	≥ 6.4 μs	≥ 3.2 μs	One square width or greater.	
Number per Field			8-9	16-17
Pulse Duration	225 ns ± 40 ns			
Horizontal Lines				
Line-to-Line Duration	35 lines	17 lines	V/15	V/30
Position Range	≥ 35 lines	> 18 lines		
Number per Field			6-7	13-14
Height	2 lines/frame			
Dots				
Width (HAD)	225 ns ± 40 ns	350 ns ± 50 ns		
Height	2 lines/frame	3 lines/frame		

ENVIRONMENTAL (all 1410 Series)

Temperature —
Operating: 0 °C to 50 °C.
Storage: − 40 ° to + 65 °C.
Altitude —
Operating: To 15,000 ft.
Storage: To 50,000 ft.

SAFETY CERTIFICATIONS (all 1410 Series)

Underwriters Laboratories, Inc.: Listed, 242T; Canadian Standards Association: Certified, LR37158; International Electrotechnical Commission (IEC 348): Certified by Tektronix, Inc.

DIMENSIONS AND WEIGHTS

Length: 19.2 in. (48.77 cm): Width: 19.0 in. (48.26 cm.): Height: 3.47 in. (8.81 cm)
Weight, typical with plug-ins, net: 21 lbs 3 oz (9.7 kg), shipped: rackmount 30 lbs 7 oz (13.8 kg).

MAINFRAME CHARACTERISTICS

1411, 1412

1411 Subcarrier — Frequency (fsc) 4.43361875 MHz ± 1 Hz. Drift: ≤ 1 part in 10^7 per week. Pull-In Range: fsc ± 20 Hz.

1412 Subcarrier — Frequency (fsc): 3.57561149 MHz ± 1 Hz. Drift: ≤ 1 part in 10^6 per week. Pull-in range: fsc ± 20 Hz.

Subcarrier Input — Amplitude: 1.0 V to 4.0 V p-p. Frequency: 4.43361875 MHz (3.57561149) ± 10 Hz. Return Loss: ≥ 46 dB to 4.43361875 MHz.

POWER SUPPLY

Mains Voltage Range — 100 V ac: 90-112 V ac. 120 V ac: 106-132 V ac. 220 V ac: 180-224 V ac. 240 V ac: 212-250 V ac.

Mains Crest Factor — ≥ 1.35.

Max Power Consumption — 130 W.

Max Amps — at 120 V ac 60 Hz — 1.2A.

Mains Frequency — 47-63 Hz.

GEN LOCK SPG12 (SPG22) ONLY

Input Configuration — 75 Ω loop-through.

Input Requirements — Sync source: 1 V nominal composite video or black burst, sync negative. Sync amplitude: 300 mV ± 6 dB. Burst amplitude: 300 mV ± 12 dB. Burst/Sync Ratio: Within 6 dB. Return loss: ≥ 40 dB to 7 MHz (SPG22 46 dB to 5 MHz).

Loss of Lock — Indicated by front-panel LED's (automatic switching to full or partial internal).

Subcarrier Phase Error with Frequency Change — Within 0.5° with input burst frequency change of ± 5 Hz.

Subcarrier Phase Error with Temperature Change — Within 5° with ambient temperature change from 0 °C to 50 °C with 1° for any 10 °C increment from 0 °C to 50 °C. (Input burst within 10 Hz of nominal, oven temp in normal range.)

Subcarrier Phase Error with Burst Amplitude Change — ± 1° with amplitude change from 210 mV to 420 mV ± 3° with amplitude range from 75 mV to 1.2 V. (Input burst frequency within 10 Hz of nominal, oven temperature in normal range, ambient temperature + 20 °C.)

Subcarrier Phase Stability (breezeway effect) — 0.2° for burst timing errors including burst width variance of 8 to 10 cycles and breezeway variance of ± 0.28 μs.

Subcarrier Phase Stability with Dynamic APL — ≤ 0.1° with APL change from 10% to 90%.

Subcarrier Phase Stability with Noise — Within 1° with RMS white noise at 24 dB below nominal p-p picture signal.

Chroma Phase Range — 360° via front-panel goniometer.

Line Sync Delay Range — Internal switch sets delay range to + 10 μs, − 4 μs. Front panel range ± ½ μs.

Subcarrier Stability (over ambient temperature range 0 °C to 50 °C) — Line lock: Within 70 ns. Subcarrier lock: Within 35 ns.

Horiz Jitter — Line lock: ≤ 10 ns. Subcarrier lock: ≤ 4 ns.

Field/frame Sync — Fast lock. Direct acting in 1 field ± 1 line time off-set provided. Slow lock: 1 line/field slow.

EXTERNAL REFERENCE INPUTS SPG11 and SPG12 (SPG22)

Input Configuration — 75 Ω loop-through.

Subcarrier Input Requirements — Amplitude: 1.0 V to 4.0 V p-p. Frequency: 4.43361875 MHz (3.57561149). Return Loss: ≥ 46 dB to 4.43361875 MHz). (3.57561149 MHz).

Comp Sync Input — Amplitude: 1.0 V to 8.0 V p-p. Polarity: negative-going. Return loss: ≥ 40 dB to 7 MHz (46 dB to 5 MHz).

Loss of Lock — Indicated by front-panel LED indicators. Automatic switching to partial or full internal reference.

Subcarrier Stability — Output follows input.

Line Sync Delay Range — Internal switch sets delay range to + 10 μs, − 4 μs. Front panel range ± ½ μs.

Chroma Phase Range — 360° via front-panel goniometer.

Pal Pulse Input — Amplitude: 1.0 to 8.0 V p-p, negative going. Waveshape: pulse or square wave. Timing: pulse duration ≥ 4 μs. Square wave rate H/2. Phasing: pulse-negative going transitions coincident with start of line sync on either a + V or − V line. Return loss: ≥ 40 dB to 7 MHz (46 dB to 5 MHz).

SYNC GENERATOR OUTPUTS EXCEPT SPG13

Output Level (into 75 Ω) — 1 V, 2 V, or 4 V (selectable) ± 0.2 V.

Return Loss — ≥ 30 dB to 5 MHz.

Isolation, Passive — Either open or short of one output shall cause an output level change at the other connector of ≤ 1% (40 dB) for all components of the signal.

Isolation, Active (non-coherent crosstalk) — A signal introduced at one output connector shall be attenuated by ≥ 30 dB at the other connector for signals between + 0.5 V and − 4.0 V in amplitude at or below color subcarrier frequency.

Rise and Fall Time SPG11/SPG12 — 10% to 90%. (Linear Ramp) Normally set to 2 V, 250 ns. Other values internally selectable.

Rise and Fall Time SPG21/SPG22 — 10% to 90%. (Linear ramp) 140 ns ± 20 ns.

COMP SYNC

Equalizing Pulse Duration — 2.40 μs (2.38 μs) ± 50 ns. Measured at 50% points.

Field Sync Pulse Duration — 27.2 μs (27.0 μs) ± 200 ns. Measured at 50% points.

Number of Pulses per Sequence — 5-5-5 (6-6-6).

Interval Between Field Sync Pulses — 4.8 μs ± 100 ns. Measured at 50% points.

Field Period — 20 ms (16.68 ms).

Line Period — 64 μs (63.56 μs).

Line Sync Duration — 4.7 μs ± 100 ns.

Jitter — ≤ 4 ns.

Comp Blanking — Line blanking duration: 12.0 μs (11.1 μs) nominal, adjustable 9 to 12 μs. Measured at 50% points. Field blanking durations: 25 (21) lines nominal, adjustable 16 to 25 (21) lines.

Burst Flag — Delay from line sync: Adjustable. Duration: 2.3 μs (2.51 μs) ± 50 ns (adjustable).

Horizontal Drive — Duration: Start of line blanking to end of line sync ± 100 ns, or line sync time.

Vertical Drive — Duration: Starts at Vertical blanking: 7½ (9) lines. Starts at Vertical Sync: 5 lines.

Field Reference — Position Field 1. Line 7 (8).

Pal Pulse — Phasing: Negative transition coincident with leading edge of line sync on either + V or − V lines. Factory set to + V. Duration: 4.7 μs, within 0.2 μs. Level 2 V 75 Ω at H/2 Rate.

Pal Pulse — Square wave (May be internally selected in place of pulse.) Level: 1 V 75 Ω H/2 rate. Phasing Transition is coincident with leading edge of line sync. Polarity may be high or low during + 135° burst lines.

V/2 — Level: 1 V 75 Ω. Rate: 25 (30) Hz square wave. Phasing: Positive during fields 2 and 4 (1 and 3). V/4 — Level: 1 V 75 Ω. Rate: 12.5 Hz (15 Hz) square wave. Phasing: Positive during fields 1 and 4 (1 and 2). 64H — Level: 1 V 75 Ω. Frequency: 1 MHz (1.006993 MHz).

Subcarrier — Amplitude: 2 V p-p ± 10% 75 Ω. Return loss: ≥ 30 dB to 5 MHz. Isolation: ≥ 40 dB.

Black Burst Amplitudes — Sync: − 300 mV ± 3 mV from blanking. Burst: absolute 300 mV ± 9 mV. Relative: alternate burst amplitudes equal within 1%. Blanking level: 0 V + 50 mV. Setup level: 0% setup (50 mV ± 2.5 mV).

Black Burst Timing SPG11/SPG12 — Sync rise time 250 ns ± 50 ns. Sync HAD: 4.7 μs ± 100 ns. Breezeway: 800 ns typical. Burst delay: 5.6 μs ± 100 ns (25 cycles of subcarrier). Burst envelope HAD: 2.25 μs ± 100 ns. Burst rise time: 350 ns ± 50 ns. Line period 64 μs. Field period 20 ms.

Black Burst Timing SPG21/SPG22 — Line blanking interval: 11.1 μs ± 250 ns. Front porch duration: 1.58 μs typical Sync/setup rise time: 125 ns ± 20 ns. Sync HAD 4.7 μs ± 100 ns. Breezeway: 1.0 μs typical. Burst delay: 5.8 μs 100 ns (21 cycles of subcarrier). Burst rise time 400 ns ± 60 ns. Burst envelope HAD: 2.52 μs ± 100 ns. Line period: 63.56 μs. Field period: 20 ms.

Other Black Burst Signal Specifications — Burst phase + 135°, − 135° on successive lines. Angle between bursts: 90° ± 1°. Residual Subcarrier: ≤ 2.5 mV. Return loss: ≥ 30 dB. f < 5 MHz. Isolation: ≥ 40 dB.

COMPOSITE VIDEO

Amplitude — Sync: − 300 mV ± 3 mV from blanking. Setup level: 0% setup (50 mV ± 2.5 mV). Pedestal: 175 mV ± 5 mV (none). Burst: Absolute, 300 mV ± 9 mV. Relative, alternate bursts are equal within 2%. U and V components, equal within 1%. Blanking level 0 V ± 50 mV.

Timing — Line blanking interval: 12.05 μs (11.1 μs) ± 250 ns. Front porch: ≥ 1.40 μs: Sync rise time: 250 ns ± 50 ns (130 ns + 20 ns − 10 ns). Sync HAD: 4.8 μs ± 200 ns. Breezeway: 800 ns (1 μs) typical. Burst delay: 5.6 μs (5.8 μs) ± 100 ns or 25 (21) cycles of subcarrier. Burst rise time: 350 ns + 50 ns (400 ns ± 60 ns). Burst envelope HAD 2.25 μs ± 230 ns (2.52 μs ± 280 ns). Line period: 64 μs (63.56 μs). Field period 20 ms (16.68 ms).

CHARACTERISTICS

Burst Phase — + 135° and − 135° on successive lines. Angle between bursts: 90° ± 1°.

Return Loss — ≥ 30 dB, f < 5 MHz.

Isolation — ≥ 40 dB.

TSG11 (TSG21)

Luminance Component Accuracy — Within 1.5 mV. or 1% of level, whichever is greater.

Chrominance Component Accuracy — Absolute amplitudes: ± 3%. Relative Amplitudes: Within 1% of red bar, or 1 mV plus p-p residual subcarrier, whichever is greater.

Bar Width — 6.5 μs + 325 ns (6.6 ± 330 ns).

Luminance Rise time — 115 ns ± 15 ns (130 ns + 20 ns − 10 ns) C/L DELAY — ≤ 20 ns.

Chrominance Rise time — 350 ns ± 50 ns (400 ns ± 60 ns).

U, V Quadrature Error — ≤ 0.5°.

V Axis Phase Switch Error — ≤ 0.5°.

Aberrations — ≤ 20 mV p-p.

Residual Subcarrier — White and blanking: ≤ 2.5 mV.

Spurious Subcarrier — End of H blanking ≤ 32 mV. Elsewhere ≤ 2.5 mV.

Other Noise — During Sync, start of White Bar, and end of H blanking ≤ 32 mV. Elsewhere: ≤ 2.5 mV.

Split Field Displays — Split is ½ — ½ or ¾ — ¼, internally selectable in SPG.

Fixed Full Field Display and ITS — Amplitude 75%. Pedestal: 0% (Setup 5%). White reference: 100%.

TSG12

Displays Available — Vertical lines, horizontal lines, dots or any combination of these (dots appear centered in the rectangles formed by the crosshatch pattern).

Rise and Fall Times — Pulses and Setup 115 ns ± ns (125 ns ± 20 ns).

Composite Video Amplitude — Sync: − 300 mV ± 3 mV from blanking. Blanking level: 0 V ± 50 mV. Setup level: 0% setup (50 mV ± 2.5 mV). Pulse amplitude: 525 mV (537.5) ± 25 mV.

TSG13 (TSG23)

Luminance Rise Time — 250 ns ± 50 ns.

Five-step Signal — Step amplitudes nominal. 140 mV. Relative: Largest within 1% of smallest. Aberrations ≤ 2% of step amplitude. Start 10t after To. Stop 31t after To. Step width: 4t.

Ten-step Signal — Step amplitudes nominal. 70 mV. Relative, largest within 1% of smallest. Aberrations ≤ 2% of step amplitude. Start: 9t after To. Step width 2t.

Ramp Signal — Start 8t after To. Stop: 28t after To. Linearity: ± 1%.

Linearity Subcarrier — Amplitudes: 140 mV ± 3%. 280 mV ± 3%. Differential gain: ≤ 0.5%. Phase 180° ± 1°. Differential phase: 0.1° Start: 6t after To, stop 29t after To. Rise time 350 ns ± 50 ns (400 ns ± 60 ns).

Note: To = Sync start;
t = 2 μs.

Flat-field Signals — Pedestal Start, 5t after To. Stop, 31t after To. Flat field subcarrier. One level start; 6t after To. Stop: 29t after To. Three-level: Amplitudes absolute 140 mV ± 3%. 420 mV ± 3%. 700 mV ± 3%. Relative percentage: within 1% of the largest chrominance amplitude, or 1.5 mV plus residual subcarrier amplitude, whichever is greater. Rise time: 350 ns ± 50 ns (400 ns ± 60 ns). Phase 90° ± 2°, internally adjustable to 60° ± 3°. Phase error: Largest amplitude to smallest ≤ 0.5°.

Bounce Modes — Ac: rate, 1/60 to ½ Hz. Dc: rate, slow 1/60 to ½ Hz. Dc rate, fast selectable: line rate, field rate, or frame rate. Offset 418.6 mV for 10% to 90% APL bounce.

TSG14

Black Burst Signal Amplitude — Sync: − 300 mV ± 3 mV from blanking. Burst: absolute 300 mV ± 9 mV, relative, alternate burst amplitudes equal within 1%. Blanking level: 0 V ± 50 mV setup level: 0% setup. (50 mV ± 2.5 mV).

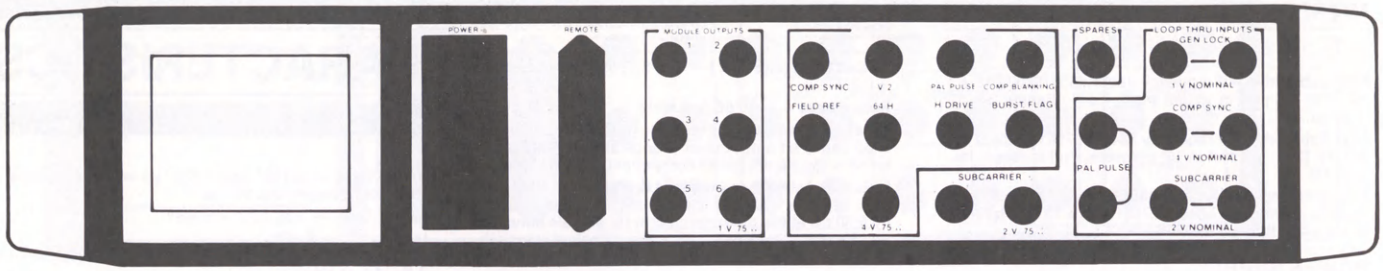
Timing — Same as TSG11.

Burst Phase — Same as TSG11.

Residual Subcarrier — ≤ 2.5 mV.

Return Loss — ≥ 30 dB, f < 5 MHz.

Isolation — ≥ 40 dB.



Rear panel of the 1411. The 1412 is similar.

TSG15

	Full Amplitude	Half Amplitude
Luminance Bar Amplitude	700.0 mV ±7.0 mV	350.0 mV ±5.3 mV
Modulated Bar Amplitude		
Luminance	350.0 mV ±3.5 mV	175.0 mV ±1.8 mV
P to P Chrominance	700.0 mV ±14.0 mV	350.0 mV ±7.0 mV
Pulse Amplitude		
2T	700.0 mV ±7.0 mV	350.0 mV ±5.3 mV
−2T	700.0 mV ±10.5 mV	350.0 mV ±7.0 mV
T	700.0 mV ±10.5 mV	350.0 mV ±7.0 mV
T/2	700.0 mV ±14.0 mV	340.0 mV ±14.0 mV
Modulated	700.0 mV ±7.0 mV	350.0 mV ±5.3 mV
Pulse to Bar Ratio		
2T	1:1 ±0.005	1:1 ±0.01
−2T	1:1 ±0.01	1:1 ±0.02
T	1:1 ±0.01	1:1 ±0.02
T/2	1:1 ±0.02	1:1 ±0.04
Modulated Pulse to Modulated Bar	1:1 ±0.01	1:1 ±0.02

Modulated Pulse and Bar	
Chrominance-Luminance Gain	3.5 mV maximum amplitude difference of peak chrominance and peak luminance.
Delay	5.0 ns maximum
Residual Subcarrier	2.0 mV maximum.
Other Baseline Errors	3.5 mV maximum.
Subcarrier Phase	
Factory Set	Fixed phase
Internal Option	Phase modulated 360° at field rate.
Subcarrier Harmonics	At least 40 dB down.

	Normal Half Amplitude Duration (HAD)	Inverted Overshoot
Luminance Pulse		
2T	200 ns ±5%	0.5%
T	100 ns ±5%	1.0%
T/2	50 ns ±10%	2.0%
Modulated Pulse		
10T	1000 ns ±5%	1.0%
20T	2000 ns ±5%	1.0%
	Risetime	**Overshoot**
Bar		
2T	192.9 ns ±10%	0.5%
T	94.4 ns ±10%	0.5%
T/2	48.2 ns ±15%	2.0%
10T Modulated	964 ns ±10%	1.0%
20T Modulated	1929 ns ±10%	1.0%
Line Tilt	0.5% maximum	

Window	
Line Timing	Bar Timing
Field Timing	White lines 65 to 270 each field
Field Tilt	0.5% maximum
Field Squarewave	
Amplitude	700.0 mV ±14.0 mV.
Field Timing	White lines 65 to 220 each field.
Field Tilt	0.5% maximum.
Pedestal	
Amplitude	
Luminance Off or Half Amplitude	350.00 mV ±7.0 mV (50%).
Luminance On and Full Amplitude	
Factory Set	Pedestal Off
Internal Option	70.0 mV to 175 mV adjustable.
Timing	From 1411 mainframe Horizontal and Vertical Blanking.
Risetime	250 ns ±50 ns.

TSG16

	Low Range	High Range
Multiburst		
Frequencies	500 kHz ±3% 1.00 MHz ±3% 2.00 MHz ±3% 4.00 MHz ±3% 4.80 MHz ±3% 5.80 MHz ±3%	1.00 MHz ±3% 3.00 MHz ±3% 5.00 MHz ±3% 8.00 MHz ±3% 10.0 MHz ±3% 12.0 MHz ±3%
Amplitude (First Multiburst Packet)		
Full	700 mV ±21 mV	700 mV ±28 mV
Reduced	420 mV ±12 mV	420 mV ±16 mV
Flatness		
Full	10 mV or less	17.5 mV or less
Reduced	10 mV or less	17.5 mV or less
Packet Envelope		
Risetime	400 ns ±60 ns	400 ns ±60 ns
Burst Phasing	Phase shifted at field rate to provide filled-in burst packets.	
Sweep/Manual		
Sine Wave Frequencies		
Start	100 kHz minimum	330 kHz minimum
Stop	6 MHz ±10%	20 MHz ±10%
Amplitude at First Marker Full	700 mV ±21 mV	700 mV ±28 mV
Reduced	420 mV ±12 mV	420 mV ±16 mV
Flatness***		
Full	10 mV	17.5 mV to 12 MHz 21.0 mV to 20 MHz
Reduced	10 mV	17.5 mV to 12 MHz 21.0 mV to 20 MHz
Markers		
Frequencies	500 kHz ±3%* 1.0 MHz ±3%* 2.0 MHz ±3%* 3.0 MHz ±3%* 4.0 MHz ±3%* 5.0 MHz ±3%*	1.0 MHz ±3%* 2.0 MHz ±3%* 4.0 MHz ±3%* 6.0 MHz ±3%* 8.0 MHz ±3%* 10.0 MHz ±4%* 12.0 MHz ±4%** 14.0 MHz ±6%** 16.0 MHz ±7%** 18.0 MHz ±7%** 20.0 MHz ±7%**

*Within one television line either side of the marker.
**Above 10 MHz, difference frequency between markers in 2 MHz ± 400 kHz.
***Max-min diode detected peak to peak voltages.

Multiburst/Manual (Last Burst Variable Mode)		
Frequency Range		
Start	<5.0 MHz	<14 MHz
Stop	>6.0 MHz ±10%	20 MHz ±10%
Accuracy	±0.2% short term	±1% short term
Amplitude (Markers & Pedestal all Modes) Markers Relative to Pedestal Level		
Full	±350 mV ±1%	±350 mV ±1%
Reduced	±210 mV ±1%	±210 mV ±1%
Pedestal Level		
Full	350 mV ±1%	350 mV ±1%
Reduced	350 mV ±1%	350 mV ±1%
Risetime	250 ns ±50 ns	250 ns ±50 ns

Harmonic Distortion (Single Frequency Relative to Fundamental)	−43 dB, 300 kHz, to 5.0 MHz −40 dB, 100 kHz, to 300 kHz −40 dB, 5.0 MHz to 6.0 MHz	−38 dB, 330 kHz, to 6.0 MHz −36 dB, 6 MHz to 20 MHz

SWITCHER

Input Signal —
Amplified Limits: 1.4 V p-p.
Input Return Loss: ≥30 dB, to 5 MHz.
Input Isolation: ≥50 dB, internal inputs.
Input Impedance: 75 Ω.

Switcher Output Signal —
Timing: Same as inputs, delayed by 10 ns (10-20° of subcarrier).
Amplitudes: Within 2% of inputs.
Blanking dc Level: 0 V ±100 mV.
Relative Blanking Level: Within 15 mV, between signals.

Added Distortion —
Noise: <60 dB, to 5 MHz.
Residual Subcarrier: <1 mV.
Differential Gain: <0.5%.
Differential Phase: <0.3°.
Luminance Linearity: 1%.
Pulse to Bar Ratio:
2T: 1:1 ±0.5%.
Tilt: <1%, line or field.
Flatness: 1% to 5 MHz.
2% to 10 MHz.
4% to 20 MHz.
Clamping:
Aberrations: <10 mV, at burst gate time.

Subcarrier Phase with Respect to Inserted (Channel B) Burst at Full Field Mode — Within 5° (system requirement depends on TSG units).

Matrix Timing — Field split into 14 unblanked horizontal strips (maximum).

Output Return Loss — ≥30 dB to 5 MHz.

CONVERGENCE — TSP11 (TSP21)

Convergence Signal
Line and Dot Pulses —
Amplitude: 525 mV ±25 mV (537.5 mV ±25 mV). (Horizontal Line bar amplitude within 1%. Rise and Fall Times: 115 ns ±15 ns (125 ns ±20 ns).

Blanking —
Dc Level: 0 V ±50 mV.
Timing: Set by SPG.
Front Porch: ≥140 μs.

Sync —
Amplitude: −300 mV ±3 mV.
Timing: Set by SPG.
Rise time: 250 ns ±50 ns (125 ns ±20 ns).

Setup —
Amplitude: 0% (Selectable 50 mV ±5 mV).
Timing: Set by SPG.
Rise time: 115 ns ±15 ns (125 ns ±20 ns).

Isolation — ≥40 dB.

Return Loss — ≥30 dB to 5 MHz.

SAFETY CERTIFICATIONS (all 1411 Series)

Underwriters Laboratories, Inc.: Listed, 242T; Canadian Standards Association: Certified, LR37158; International Electrotechnical Commission (IEC 348): Certified by Tektronix, Inc.

TSP11

Convergence Pattern	Large Squares	Small Squares	Large Squares	Small Squares
Vertical Lines				
Line-to-Line Duration	6.4 μs	3.2 μs	H/10	H/20
Position Range	>6.4 μs	>3.2 μs	One square width or greater.	
Number per Field			8-9	16-17
Pulse Duration	225 ns ±40 ns			
Horizontal Lines				
Line-to-Line Duration	42 lines	21 lines		
Position Range	≥42 lines	>21 lines		
Number per Field			6-7	13-14
Height	2 lines/frame			
Dots				
Width (HAD)	225 ns ±40 ns	350 ns ±50 ns		
Height	2 lines/frame	3 lines/frame		

CHARACTERISTICS

TSP21

Convergence Pattern	Large Squares	Small Squares	Large Squares	Small Squares
Vertical Lines				
Line-to-Line Duration	6.36 μs	3.18 μs	H/10	H/20
Position Range	≥6.4 μs	≥3.2 μs	One square width or greater.	
Number per Field			8-9	16-17
Pulse Duration	225 ns ± 40 ns			
Horizontal Lines				
Line-to-Line Duration	35 lines	17 lines	V/15	V/30
Position Range	≥35 lines	>18 lines		
Number per Field			6-7	13-14
Height	2 lines/frame			
Dots				
Width (HAD)	225 ns ± 40 ns	350 ns ± 50 ns		
Height	2 lines/frame	3 lines/frame		

ENVIRONMENTAL (all 1411 Series)

Temperature —
Operating: 0 °C to 50 °C.
Storage: −40 °C to +65 °C.

Altitude —
Operating: To 15,000 ft.
Storage: To 50,000 ft.

DIMENSIONS AND WEIGHTS

Length: 19.2 in. (48.77 cm): Width: 19.0 in. (48.26 cm.): Height: 3.47 in. (8.81 cm)
Weight, typical with plug-ins, net: 21 lbs 3 oz (9.7 kg), packed rackmount 30 lbs 7 oz (13.8 kg).

ORDERING INFORMATION

IMPORTANT ORDERING INFORMATION

The 1410 NTSC, 1411 PAL, and 1412 PAL-M Sync Pulse and Test Signal Generator Series are designed to provide you with high quality performance, package flexibility, and economy. Our card set construction allows you to order just the capabilities you need while leaving room for future expansion. For easy ordering of a 1410 or 1411 Generator, follow the easy steps listed here.

The 1412 PAL-M Generator is available in only one configuration.

1. Select the functions you need. Choose from two mainframes for the 1410 (NTSC), one mainframe for the 1411 (PAL), two sync pulse generators or one timing generator, and six test signal generators and one switcher. Put together just about any combination you desire. Some typical packages are listed later in this section.
2. If you are ordering a 1410 or 1411 Generator and one or more modules that you want delivered tested as a package, your purchase order must include Option 88. Option 88 directs us to assemble, calibrate, and ship your 1410 or 1411 Series Generators as a single unit package.
3. If you already own a 1410 or 1411 Generator and are adding functions to your package, you need order only the generator required.
   Do not order Option 88 when adding a generator to a 1410 or 1411 package you already own.
4. If you are ordering more than one 1410 or 1411 Generator package on the same purchase order, be sure to indicate the specific functions (generators) to be included in each package.

TYPICAL 1410 SYNC GENERATOR PACKAGES

1. Master sync generator without gen-lock and ± 10 Hz color standard (Rackmount).
   Order:
   1410R Generator Option 88.
   SPG1 Sync Generator Option 88.
2. Master sync generator without gen-lock and ± 1 Hz color standard (Rackmount).
   Order:
   1410R Generator Option 01 Option 88.
   SPG1 Sync Generator Option 88.
3. Master sync generator with gen-lock and ± 10 Hz color standard (Rackmount).
   Order:
   1410R Generator Option 88.
   SPG2 Gen-lock Sync Generator Option 88.
4. Master sync generator with gen-lock and ± 1 Hz color standard (Rackmount).
   Order:
   1410R Generator Option 01 Option 88.
   SPG2 Sync Generator Option 88.

TYPICAL 1411 SYNC GENERATOR PACKAGE

1. Master sync generator without gen-lock (Rackmount).
   Order:
   1411R Generator Option 88.
   SPG11 Sync Generator Option 88.
2. Master Sync Generator with gen-lock and ± 1 Hz color standard (Rackmount).
   Order:
   1411R Option 88.
   SPG12 Sync Generator Option 88.

POSSIBLE 1410 TEST SIGNAL GENERATOR PACKAGES

1. Master sync generator with gen-lock, ± 10 Hz color standard, with all test signals and switcher.
   (Rackmount).
   Order:
   1410R Generator Option 88.
   SPG2 Gen-lock Sync Generator Option 88.
   TSG1 Color Bars Generator Option 88.
   TSG3 Linearity Generator Option 88.
   TSG5 Pulse and Bar Generator Option 88.
   TSG6 Multiburst Generator Option 88.
   TSP1 Switcher Option 88.
2. Sync Generator (sync generator outputs not required), ± 10 Hz color standard, with all test signals and switches.
   (Rackmount).
   Order:
   1410R Generator Option 88.
   SPG3 Sync Generator Option 88.
   TSG1 Color Bars Generator Option 88.
   TSG3 Linearity Generator
   TSG5 Pulse and Bar Generator Option 88
   TSG6 Multiburst Generator Option 88
   TSP1 Switcher/Convergence Generator Option 88

See additional ordering information on following page.

ORDERING INFO

POSSIBLE 1410 TEST SIGNAL GENERATOR PACKAGES

1. Master sync generator with gen-lock, with all test signals and switcher (Rackmount).

   Order:
   1411R Generator Option 88.
   SPG12 Gen-lock Sync Generator Option 88.
   TSG11 Color Bars Generator Option 88.
   TSG13 Linearity Generator Option 88.
   TSG15 Pulse and Bar Generator
   TSG16 Multiburst and Video Sweep Generator
   TSP11 Switcher/Convergence Generator

2. PAL sync, no pulse outputs required with all test signals and switcher (Rackmount).

   Order:
   1411R Generator Option 88.
   SPG13 Sync Generator Option 88.
   TSG11 Color Bars Generator Option 88.
   TSG13 Linearity Generator Option 88.
   TSG15 Pulse and Bar Generator
   TSG16 Multiburst and Video Sweep Generator
   TSP1 Switcher/Convergence Generator

   There are many other 1410 and 1411 Test Signal Generator packages available. Choose the combination that best suits your needs. A Tektronix Television Sales Engineer will gladly assist you in selection of test signal generator packages.

ORDERING INFORMATION

When ordering, please use nomenclature given here.

	Generators		
	1410 NTSC	1411 PAL	1412 PAL-M*
Mainframe (Cabinet) (10 Hz)	1410C		
Mainframe (Cabinet) (1 Hz)	1410C Opt 01	1411C	1412C
Mainframe (Rackmount) (10 Hz)	1410R		
Mainframe (Rackmount) (1 Hz)	1410R Opt 01	1411R	1412R
Sync Generator	SPG1	SPG11	
Sync Generator with gen-lock	SPG2	SPG12	SPG22
Test Signal Timing Generator	SPG3	SPG13	
Automatic Change Over Unit (see p. 36)	GV3257A	GV3257A	GV3257A
Color/Colour Bars Generator**	TSG1	TSG11	TSG21
Convergence Generator	TSG2	TSG12	
Linearity Generator	TSG3	TSG13	TSG23
Black Burst Generator	TSG4	TSG14	
Pulse and Bar Generator	TSG5	TSG15	
Multiburst and Video Sweep Generator	TSG6	TSG16	
Switcher/Convergence Generator	TSP1	TSP11	TSP21

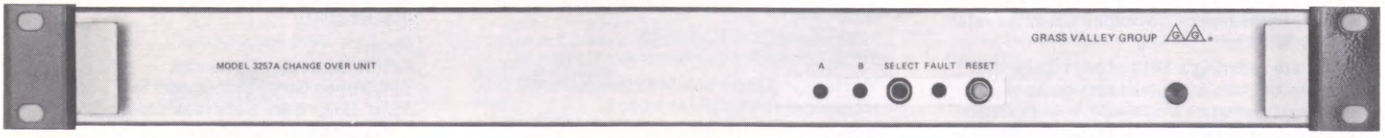
Optional Item — 333-2171-00 One-wide blank panel.

Option 88 (test together as a package). This option line should be used with each item whenever you want your group of 1410 or 1411 Series Generators delivered assembled and tested as a package.

*Each 1412C and 1412 R package contains an SPG22, TSG21, TSG23, and a TSP21.

**Only one TSG1 (TSG11) per mainframe can be accomodated.

GV3257A AUTOMATIC CHANGE OVER UNIT



The GV3257A Automatic Change Over unit serves as a transfer device between the outputs of two selectable sync pulse generators. It is applicable to all television standards — NTSC, PAL, PAL-M, and SECAM.

CONTROL LOGIC GENERATOR

This module contains 8 detectors that provide sensing for 8 of the 9 output lines. All detectors are adjustable to operate with nominal 2 or 4 V pulses and 1 or 2 V subcarrier signals. One of the detectors has increased sensitivity to permit sensing of a low level, steady state signal, e.g., color black or encoded pulse reference.

Switches are provided to disable any or all of the detectors individually.

The basic logic for automatic operation of the switch ensures that a transfer will always occur when a previously correct output condition changes to a fault condition. If the alternate input is also faulty, the switch will not return to the previous state. This feature prevents continuous cycling between two faulty sync generators.

In addition to the individual detector inhibit switches, a master automatic/manual switch is provided. Use this switch for maintenance, special gen-lock situations, etc.

LOCAL CONTROLS AND INDICATORS

The following controls and indicators are accessible from the front of the rack-mounting equipment:

- Manual transfer (mechanical linkage).
- Electrical transfer switch.
- A input ON light.
- B input ON light.
- Fault indicator light.
- Fault indicator reset switch.
- Automatic/manual switch.
- Power ON light.

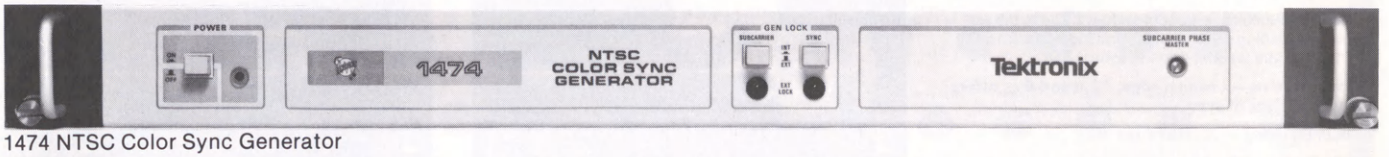
Whenever a fault occurs, the fault light is illuminated and latched ON. Turn off the fault light with the fault indicator reset switch when the fault is corrected.

All of the above controls and indicators, except the manual transfer and auto/manual switches, can be remotely located. The remoted functions operate in parallel with the local functions.

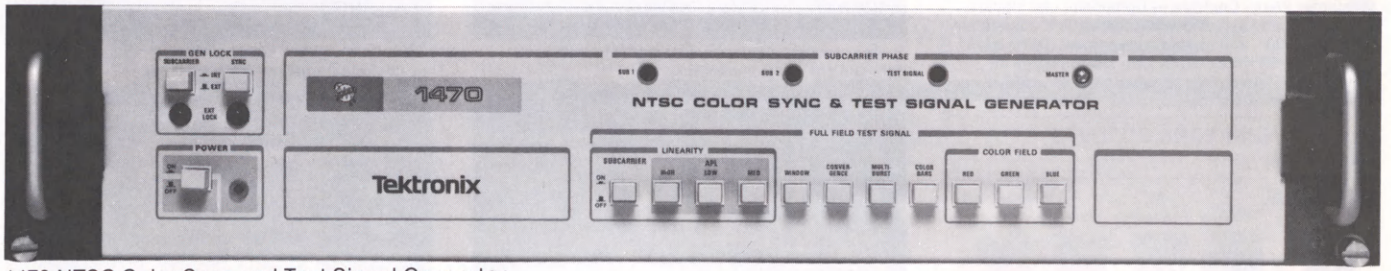
ALARMS

A relay with isolated C contacts is provided for remote alarm use. The relay is normally energized. Whenever a fault condition occurs, the relay will be de-energized until the condition is corrected. When the system is operating in the automatic mode and a transfer is made to correct a fault, the result will be a momentary pulsing of the alarm relay of approximately 100 ms.

1470 SERIES NTSC GENERATORS



1474 NTSC Color Sync Generator



1470 NTSC Color Sync and Test Signal Generator

1470 and 1474 Features

Full color sync generator with gen-lock

Locks to most helical scan VTRs

Simple to operate

Compact and economical

Sync and timing signals

- Comp sync
- Comp blanking
- Vertical drive
- Horizontal drive
- Burst gate
- Subcarrier
- Black burst

1470 Only Features

Test signals:

- Black burst
- Color bars
- Staircase signals
- Window
- Convergence pattern
- Multiburst
- Red field
- Green field
- Blue field

Simplified timing via multiple subcarrier phasing controls

The 1470 Sync and Test Signal Generator is a compact, full color, gen-lock sync generator providing a full selection of high quality test signals.

The 1474 is identical in performance to the 1470 with the exception of test signals which, in the interest of economy, are not included. Both products have color gen-lock compatible with composite video from all normal sources including most helical scan video tape recorders.

The 1470 and 1474 have rack heights of 3.5 and 1.75 in. respectively. Both are shipped ready to install into a 19 in. rack.

1470/1474 SYNC PULSE GENERATORS

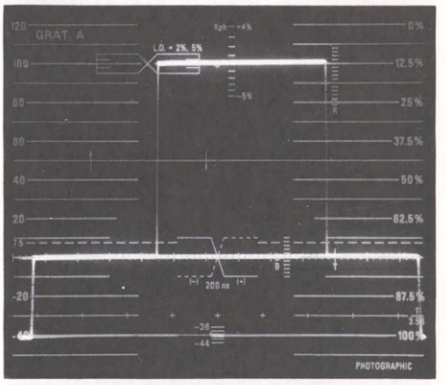
The synchronizing functions of the 1470 and 1474, like those of other Tektronix Generators, are of high quality. These generators can operate as master-sync generators or as units fully or partially timed from external sources. Color gen-lock capable of locking to most helical scan VTRs is a standard feature.

Front-panel pushbutton selection of external synchronization is provided. In external mode, the 1470 and 1474 automatically lock on composite video (1 V), composite sync (– 4V), or reference subcarrier (2 V). Two front-panel lights show subcarrier and/or sync external lock. Lights out indicate a switch to internal standard.

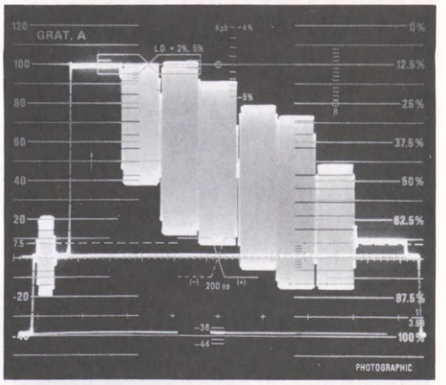
The GV3257A Changeover Unit is compatible with the 1470 and 1474.

All 1470 and 1474 generators include adjustments for varying the following timing signals:

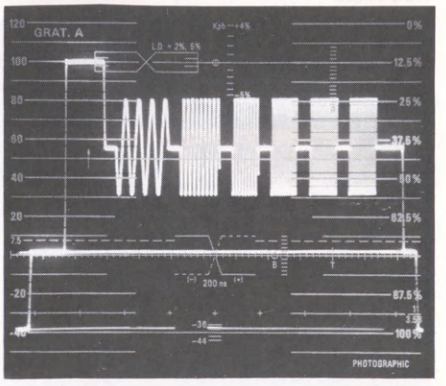
Window



Color Bars



Multiburst



1470 SERIES

Horizontal Blanking — Leading edge: 2.2 μs to 0.6 μs before the leading edge of sync. Trailing edge: 9.1 μs to 10.7 μs after the leading edge of sync.

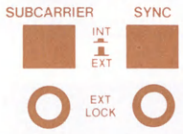
Horizontal Drive — Leading edge: 2.2 μs to 0.6 μs before the leading edge of sync.

Vertical Blanking — 20 or 21 lines.

Subcarrier Phase Controls — Composite test signals: subcarrier 1 and 2, blackburst: independent adjustment range of ≈120°, and jumper arrangement giving a full 360° shift in 90° increments. Gen-lock (master): independent 360° front panel adjustment and 100° remote control, via a rear-panel BNC connector.

SYNC GENERATORS OUTPUTS (1470/1474)

GEN-LOCK



Composite Sync — Output level into 75 Ω: 4V ±0.5V. Rise and fall time: 140 ns nominal.

Composite Blanking — Output level into 75 Ω: 4V ±0.5V. Field blanking rise and fall time: 140 ns nominal.

Vertical Drive — Output level into 75 Ω: 4V ±0.5V. Rise and fall time: 140 ns nominal. Duration: 9 lines.

Horizontal Drive — Output level into 75 Ω: 4V ±0.5V. Rise and fall time: 140 ns nominal. Duration: 6.35 μs.

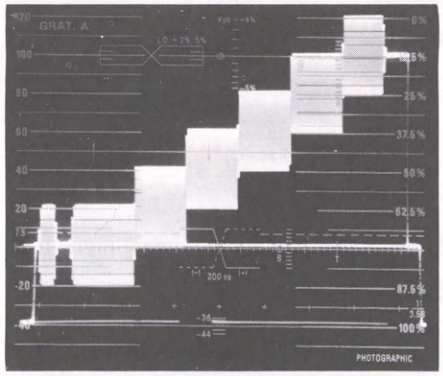
Burst Gate — Output level into 75 Ω: 4V ±0.5V. Delay from line sync: 5.1 μs ±0.1 μs. Rise and fall time: 140 ns nominal. Duration: 2.5 μs ±100 ns.

Subcarrier — Output level into 75 Ω: 2V. Frequency: 3.579545 MHz ±10 Hz.

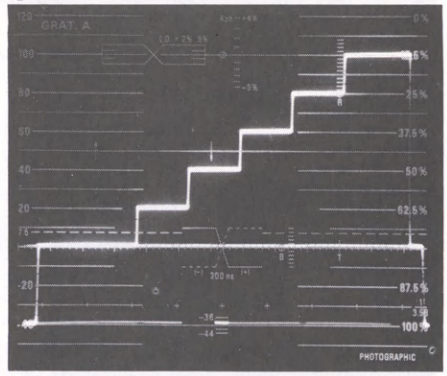
Black Burst — Sync amplitude into 75 Ω: 40 IRE. Burst amplitude: 40 IRE (286 mV p-p). Burst frequency: 3.579545 MHz ±10 Hz.

Gen-lock Signal Loop Input — Composite video input range: 0.5V to 1V when loop-through connectors are externally terminated into 75 Ω. Comp sync 1 to 4V, ref subcarrier 1.5 to 2V p-p.

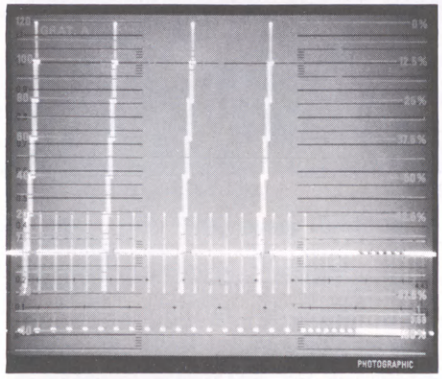
Linearity



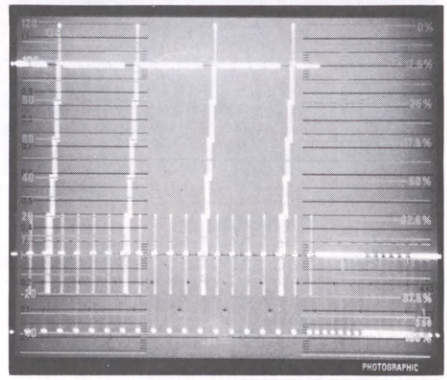
5 -step modulated linearity test signal for differential gain and phase measurements.



5-step linearity test signal without modulation for gray-scale evaluating, gray-scale tracking.



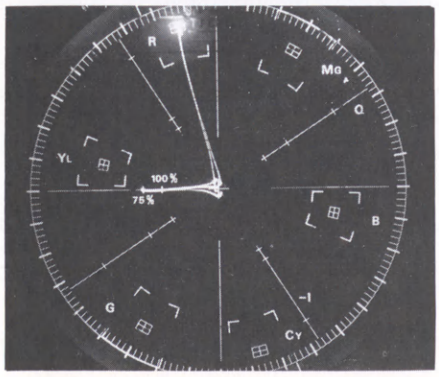
The staircase linearity test signal is useful in measuring non-linear distortions. Note four lines at 0 IRE alternated with a staircase for tests at a low APL.



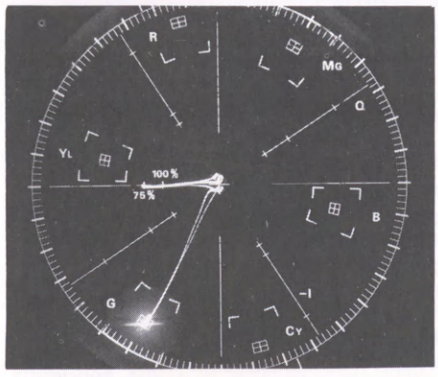
Four lines at 100 IRE alternated with a staircase line for tests at high APL.

1470 TEST SIGNAL FUNCTIONS

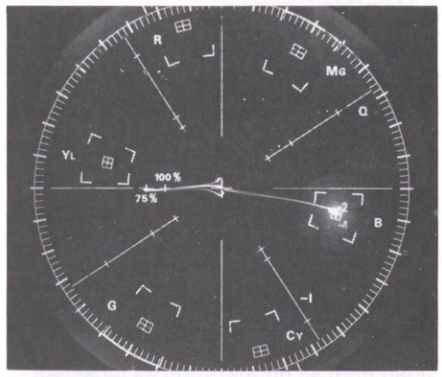
To simplify your test signal selection and speed testing operations, the 1470 has push button selection of test signals. All test signal push buttons, except the color field selectors, are self-cancelling.



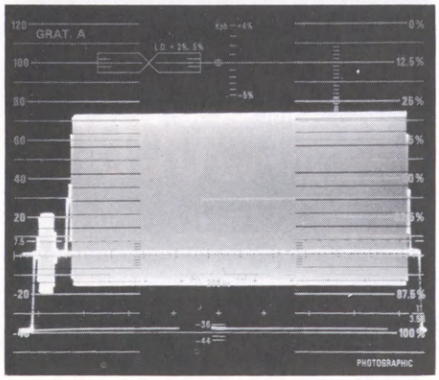
Red Field

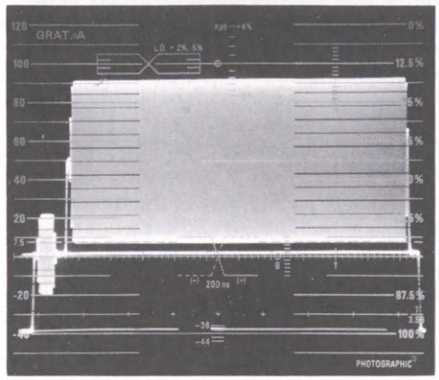


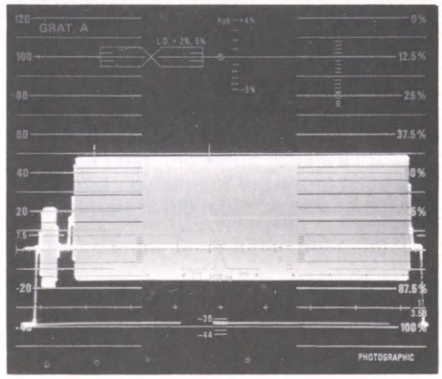
Green Field

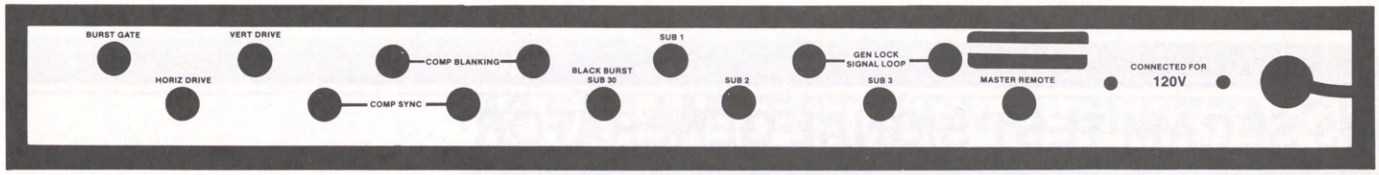


Blue Field

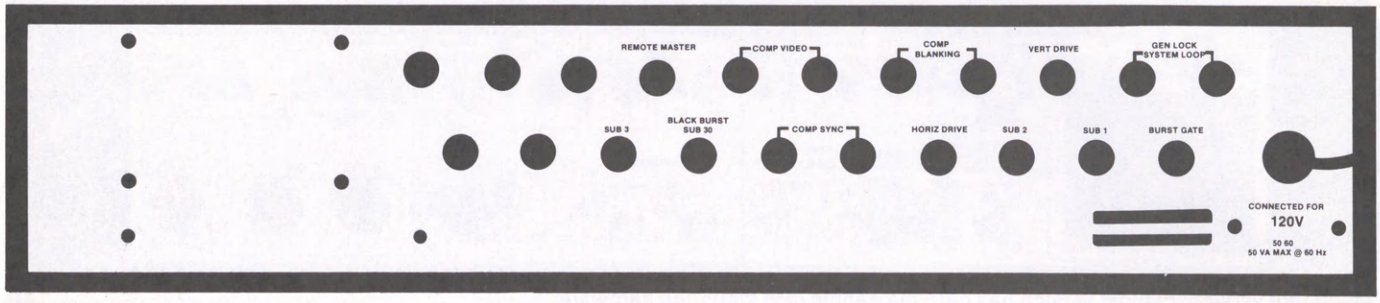








1474 Rear Panel



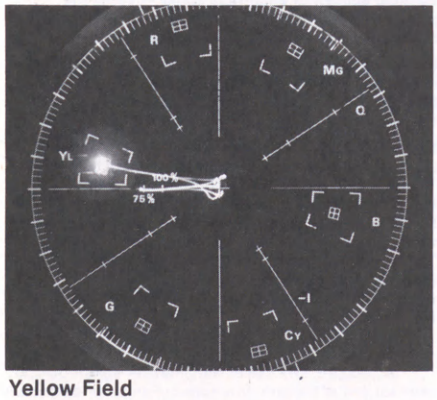
1470 Rear Panel

Each test signal provides essentially aberration-free transitions and accurate flat levels. Specifications for the test signals are under Characteristics later in this section.

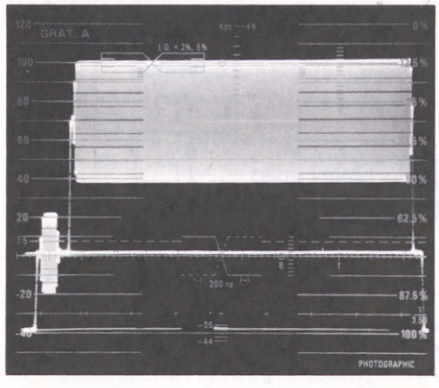
COLOR BARS

The 1470 provides a full-field color bars signal. Color bars are useful for color monitor adjustments, VTR tape lead in, and system checks.

NTSC Color Bars — Full field: 75% amplitude, 100 IRE white reference, 7.5% setup. Luminance signal accuracy: within 2%. Chrominance signal absolute amplitudes: within 3% (all subcarrier frequency components).



Yellow Field



COLOR FIELDS

Red, green, and blue color field signals are provided for checking purity on color monitors/receivers that do not have individual gun on/off controls. These signals may also be used to provide a color background source. The red, green and blue selectors may be used simultaneously to provide yellow, cyan, magenta, and white full field signals.

WINDOW, CONVERGENCE, MULTIBURST

Test Signals available include:

Window signal suitable for measuring both line time and field time distortion.

Convergence test signals for checking color monitor convergence and linearity, and camera scanning linearity. (Not shown)

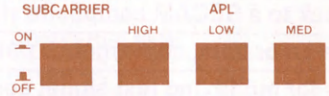
Multiburst signal for checking system frequency response.

Window Amplitude — 100 IRE, ±2 IRE. Duration: 25.8 μs, ±3%. Starts at line 66 in each field and ends at 218 in each field. Rise time: 150 ns nominal.

Crosshatch Pattern or Dots — Setup: 7.5 IRE ±1 IRE. Peak level: 77 IRE ±2 IRE. Rise and fall time: 150 ns nominal.

Multiburst — White reference amplitude: 100 IRE ±2% IRE. Multiburst amplitude: 50 IRE ±2% IRE. Average level: 55 IRE ±1 IRE. Multiburst frequencies: 0.5 MHz, 1.5 MHz, 2.0 MHz, 3.0 MHz, 3.58 MHz, 4.2 MHz.

STAIRCASE



LINEARITY (STAIRCASE)

Staircase signal with selection of high, medium, or low APL. Staircase subcarrier may be switched on or off from the front panel.

Staircase Luminance Component — 5 step amplitude (each step): 20 IRE ±1 IRE (143 mV). Staircase amplitude: 100 IRE ±2 IRE (714 mV). Aberrations: within 2% of step amplitude. Step rise time: 150 ns nominal.

Staircase Subcarrier Chrominance Component — Amplitude: 40 IRE ±1 IRE (286 mV p-p). Phase: 180°. Differential phase: ≤0.3°. Differential gain: ≤0.5%. Subcarrier envelope rise time: 400 ns nominal.

1470 Test Signal Generator Outputs Composite Video — Return loss: ≥30 dB to 5 MHz. Output level into 75 Ω: 1 V. Sync: 40 IRE, ±1 IRE (286 mV nominal amplitude). Peak video level: ±100 IRE, ±2 IRE (714 mV nominal amplitude). Blanking dc level: 0 V, ±50 mV.

OTHER CHARACTERISTICS

1470 Power Requirements — 115V or 240V line voltage, High-Low Ranges. Selection switches for line voltages and ranges are accessible internally. Factory-set to 120V. 120V Range — High, 108V to 132V; Low, 95V to 110V. 240 Range — High, 216V to 250V; Low, 198V to 242V. Line Frequency: 50-60 Hz. Power max: 50W. 1474 Power Requirements — 115V: 90-130V. 240V: 198V to 250V. Power: max 40W.

ORDERING INFORMATION

1470 Color Sync and Test Signal Generator

Option 01, Sync Generator without Gen-lock

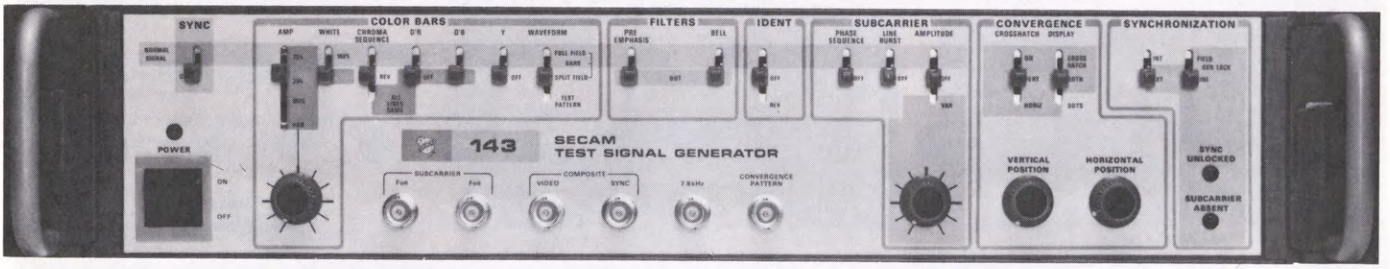
1474 Color Sync Generator

Option 01, Sync Generator without Gen-lock

Rack Mounting — The 1470 and 1474 are shipped ready to install.

GV3257A Automatic Change Over Unit

143 SECAM TEST SIGNAL GENERATOR



Rackmount version: cabinet version has carrying handle less mounting hardware.

Stand-alone broadcast-quality SECAM sync and test signal generator

Will gen-lock to a SECAM composite video signal

Composite color bars, convergence patterns, and RGB color bar signals

Provisions for modifying test signal components

The Tektronix 143 SECAM Test Signal Generator provides all the test and drive signals required to align and maintain SECAM television equipment. You can easily control all test signal components and synchronization modes from the front panel. Easy-to-change internal programming provides additional test signal capability to satisfy your unique testing requirements.

Test signals provided by the 143 are fully-encoded color bars, convergence pattern, and RGB color bar signals. You can select color bars in either a full-field or split-field configuration. Amplitude, white level, and chroma sequence can be changed from the front panel. You can also switch off the D'R, D'B and Y signal components individually using front panel controls.

The convergence pattern consists of movable vertical and horizontal lines plus dots. All three signals are available in any combination. A 7x9 or 14x17 crosshatch pattern may be internally selected.

RGB color bars signals are available from three separate rear-panel outputs at all times and are independent of the position of the front panel controls.

The 143 may be operated from its own internal standards or gen-locked to a SECAM composite video signal. Color lock may be referenced to either the vertical identification signals or the line burst. Front panel LEDs indicate the gen-lock status.

Additional outputs provide useful auxiliary signals including line and field drive, line and field blanking, composite sync, and two specialized output signals. These two signals are a 12.5 Hz square wave (for identification of the SECAM 4 field sequence), and a 7.8 kHz square wave (for synchronizing a waveform monitor to view either D'B or D'R lines only, while the 143 is generating a complete test signal). As a special convenience, the two unmodulated carrier (rest) frequencies are brought out to the front panel. It's easy to verify 143 calibration whenever routine maintenance or recalibration is performed.

DECODER AND PICTURE MONITOR OPERATIONAL TESTS

As a versatile source of high-quality test signals the 143 can be used for a number of operational tests. We've described a few of those tests here to illustrate how the test signal control and modification capability of the 143 can be used.

Comparison of chrominance demodulation channels — An important step in insuring proper decoding of the SECAM video signal is the matching of the chrominance demodulation channels. This will help eliminate hue errors in the decoded picture. With the 143 chroma sequence switch in the all-lines-same position and D'R switched off, all lines of the active picture portion of the 143's composite video signal signal will contain the D'B subcarrier modulated by the D'B chrominance signal. This allows simultaneous comparison of the two chrominance demodulator channels in a decoder. With D'R on and D'B off all lines of the active picture portion of the composite video signal will contain the D'R subcarrier modulated by the D'R chrominance signal.

Chrominance sequence detection — The 143 is a useful tool in SECAM decoder design and maintenance since it has the ability to verify chrominance sequence detection based on either line burst or vertical identification signals.

The D'R'D'B sequence can be reversed by switching the chroma sequence control between its normal and reverse positions. The vertical identification signals can be reversed with respect to the D'R'D'B sequence present during the active picture by using the reverse position of the identification control.

Color-killer operation — Proper color-killer operation of color monitor decoders can be verified by deleting either the 143's line burst or vertical identification signals.

Checking and adjusting picture monitors — Proper adjustment of picture monitor linearity and convergence can be checked using the generator's convergence signal. Positionable vertical and horizontal lines plus dots may be selected in any combination.

ENCODER OPERATIONAL TESTS

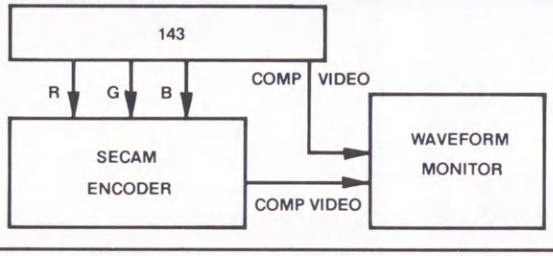
Encoder luminance level setup — Proper setup of the encoder luminance levels will help insure correct saturation in the decoded picture. Use the RBG outputs of the 143 for your encoder inputs (figure 1). Feed composite video from the encoder to input A of a Tektronix 1481 Waveform Monitor. Feed composite video from the 143, with D'R'D'B subcarriers turned off, to input B of the 1481. Using the A-B function of the 1481 the encoder gain controls can be adjusted until the two inputs exactly cancel each other.

Encoder subcarrier amplitude setup — Using the preceding setup, turn off Y and turn on the subcarriers of the 143 and compare the two waveforms.

Encoder modulation linearity — Verification of encoder modulation linearity is a key part of encoder setup. Non-linear modulation can cause both hue and saturation shifts.

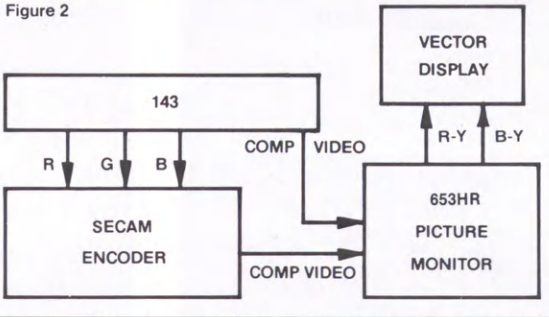
Use the RGB outputs of the 143 to drive the encoder (figure 2). Feed the encoder into the A input of a Tektronix SECAM Picture Monitor. The monitor provides R-Y B-Y vectorscope drives which are fed into a 604 Option 08 or 602 Option 08 Vector Display unit. Composite video from the 143 is fed into input B of the monitor. The encoder now can be adjusted until the dots representing color bars' vector positions do not change position as the monitor is switched between the A and B inputs.

Figure 1



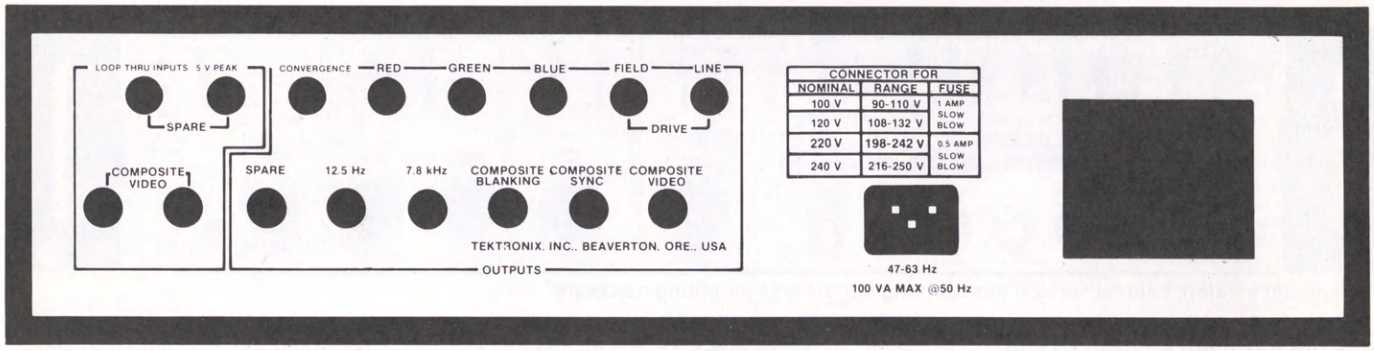
Encoder luminance level and encoder subcarrier setup test configurations.

Figure 2



Encoder modulation linearty test configuration using the new Tektronix SECAM color picture monitor as a decoder.

143 SECAM TEST SIGNAL GENERATOR



Rear Panel. BNC connectors are standard, miniQUICK connectors are available (Option 01).

CHARACTERISTICS

SYNC AND BLANKING

Line Frequency — 15.625 Hz ±0.0001%.

Line Period — 64 μs ±0.0001%.

Line Sync — Pulse duration: 4.7 μs ±0.2 μs. Pulse amplitude: −300 mV within 1% from Blanking dc level. Front porch: 1.5 μs ±0.3 μs. Pulse rise time (10-90%): 0.2 μs ±0.02 μs. Interval (sync leading edge to end of subcarrier blanking): 5.6 μs ±0.2 μs.

Line Blanking — Duration: 12 μs ±0.3 μs. Dc level: 0 mV within 100 mV.

Field Frequency — 50 Hz.

Field Period — 20 ms.

Equalizing Pulse Duration — 2.35 μs ±0.1 μs.

Equalizing Sequence Duration — 2.5 lines.

Field Synchronizing Pulse Duration — 27.3 μs ±0.2 μs.

Field Synchronizing Sequence Duration — 2.5 lines.

Field Synchronizing Rise Time — (10-90%) — 0.2 μs ±0.02 μs.

Field Blanking — Duration: 1.6 ms + (12 μs ±0.3 μs). Dc Level: 0 mV within 100 mV.

GEN-LOCK

Sync Source — Nominal 1V composite video. Input configuration 75 Ω loop-through. Return loss: ≥46 dB to 5 MHz.

Sync Amplitude — 300 mV, within 10 dB.

Sync Acquisition Time — <0.6.

D'R'D'B Lock-up Level — Subcarrier amplitudes from +6 dB to −18 dB of nominal.

D'R'D'B Drop-out Level — Subcarrier amplitudes < −18 dB of nominal.

D'R'D'B Acquisition Time — Line: <100 lines (referenced to line burst). Field: <300 ms (referenced to field identification signals).

Line Sync Delay — Range: Adjustable to advance or delay 143 sync ≥500 ns. Stability: Within 70 ns over operating temperature range. Jitter: ≤5 ns.

Lock-Up Range — Gen-Lock 15.625 kHz ±0.0005% (subcarrier is asynchronous with respect to line for line rates above and below tolerance). Sync-Lock: 15.625 kHz to ±0.1%.

PULSE OUTPUTS

Amplitude — 1, 2 or 4V negative going from ground.

Composite Sync — Identical to sync contained in the Composite Video, except rise time.

Composite Blanking — Identical to blanking for the Composite Video.

Line Blanking Duration — 12 μs ±0.3 μs.

Field Blanking Duration — 1.6 ms + (12 μs ±0.3 μs).

Line Drive Duration — 4.7 μs ±0.2 μs.

Field Drive Duration — 5 lines.

12.5 Hz Square Wave — Repetition rate: 1 cycle/4 fields (12.5 Hz). Levels: Ground for fields 1 & 2, negative for fields 3 & 4.

7.8 kHz — Repetition Rate: 1 cycle/2 lines (transition at leading edge of line drive). Levels: Ground for D'R, negative for D'B.

Output — Rise time (10-90%): 0.25 μs ±0.05 μs (all pulse outputs listed). Return loss: ≥30 dB to 4 MHz (all pulse ouputs listed).

Subcarrier Output — D'R'D'B Subcarrier: ≈1V into 50 Ω (for frequency counter).

COMPOSITE VIDEO

Outputs — Full-field or split-field color bars or test pattern.

Return Loss — ≥36 dB to 7 MHz.

Isolation Between Outputs — ≥40 dB.

Suppression of Subcarrier at Blanking — ≥46 dB (referenced to nominal subcarrier amplitude).

Rise Time of Subcarrier Envelope at Blanking — 400 ns ±100ns.

Bell Filter — Center frequency: 4.286 MHz ±20 kHz. Response: ±0.5 dB of theoretical (subcarrier ≥ −20 dB referenced to nominal amplitude). Off: Response flat ±0.5 dB 3.9 to 4.75 MHz.

Chrominance/luminance Timing — Within ±50 ns (based on red-blue transition of the D'R line).

Luminance Rise Time — 100 ns ±10 ns.

Color Bar Signal Subcarrier Tolerance — Frequency: ±(1.3% of deviation +1 kHz). Amplitude: D'B line burst 166.7 mV ±10% (subcarrier amplitude at other frequencies, relative to D'B line burst, determined by Bell filter tolerance). Variable: ≈ +6 dB to −54 dB relative to nominal amplitude.

Color Bar Signal Luminance Tolerance — Amplitude: ±1% or 1.5 mV, whichever is greater.

NON-ENCODED OUTPUT

RGB Amplitude — 525 mV ± 1% (except white, 700 mV).

RGB Sync — −300 mV ± 2% green only (delete by moving internal jumper.)

RGB Return Loss — ≥36 dB to 6 MHz.

CONVERGENCE

Pedestal — 0 V.

Sync Amplitudes — 300 mV ±5%.

Peak Luminance Level — 525 mV ±5%.

Isolation — ≥40 dB.

Return Loss — ≥35 dB to 5 MHz.

Displays — Vertical lines. Horizontal lines. Dots or any combination of the above.

POWER

Maximum Power Consumption — 100 W.
Mains Frequency Range: 48-62 Hz.

Crest Factor — ≥1.35.

Mains Voltage Range — 100 V: 90-110 Vac. 120 V: 108-132 Vac. 220 V: 198-242 Vac. 240 V: 216-250 Vac.

DIMENSIONS AND WEIGHTS

	Cabinet		Rackmount	
	in	cm	in	cm
Height	3.5	8.9	3.5	8.9
Width	16.75	42.0	19.0	48.3
Length	18.50	47.1	18.5	47.1
	lb	kg	lb	kg
Net Weight	20.0	9.1	20.5	9.3

ORDERING INFORMATION

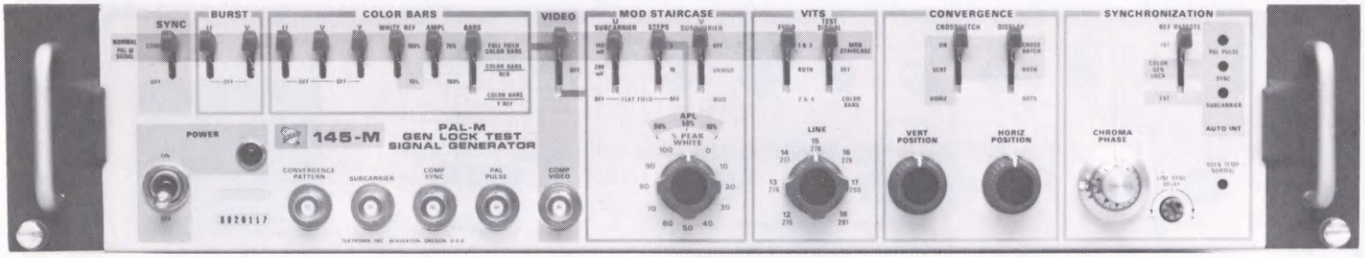
When ordering please use the exact nomenclature given here:

143 SECAM Test Signal Generator (Cabinet)

R143 SECAM Test Signal Generator (Rackmount)

Option 01 miniQUICK connectors

145-M PAL-M GENERATOR



Rackmount version; cabinet version has carrying handle less mounting hardware.

MASTER SYNC PULSE GENERATOR WITH COLOR GEN-LOCK

TEST SIGNAL GENERATOR

- **Full-field color bars**
- **Split-field color bars/Red**
- **Split-field color bars/Y ref**
- **Staircase**
- **Modulated pedestal**
- **Convergence signal**

The 145-M PAL-M Gen-Lock Test Signal Generator is a source of high-quality television test signals for 525 line, 60 Hz field, PAL-M (3.57561149 MHz Subcarrier) color TV systems. The 145-M can be color gen-locked to a composite video signal source, or referenced to external subcarrier, sync and PAL Pulse, or operated as a master sync pulse generator with its own internal frequency standard.

The 145-M provides PAL-M color bars (full field or split field), 5 or 10 step staircase (modulated or unmodulated), modulated pedestal, flat field, fixed and variable APLs — all available as full field test signals. A convergence pattern signal for converging receivers and monitors is also available, independent of and separate from the other test signals.

If synchronization is lost while the generator is operating in the externally referenced modes, front-panel lights will indicate loss of lock and automatic switching by the 145-M to internal references. The lights can be programmed internally to show normal conditions as all lights "off" or all lights "on". The 145-M's reference mode switch can be remoted, along with the indicator light functions, via the rear panel.

Recognition circuits for field sync, line sync, burst phase, and alternate-line phase allow the 145-M to gen-lock to the burst phase, subcarrier, line, field, and frames of a composite video signal applied to the loop-through GEN-LOCK inputs. In the COLOR GEN-LOCK Reference synchronization mode, the 145-M has fast gen-lock or slow (controlled-rate) gen-lock for broadcast applications.

Color Bar Signals

The normal color bar output signal is full field, on every active line, with fully saturated, 75% amplitude bars in descending luminance order. Two other color bar signals provide 100% amplitude and 75% white reference. All 145-M color bars have a 5% setup level.

Color Bars/Red and Color Bars/Y Ref displays give added flexibility. In the Color Bars/Red split field display, the lower half of the display is filled with the same red as the red color bar. This split field display is especially useful in VTR setups. In the Color Bars/Y Ref split field display, the upper half of the display shows 100% saturation of the standard color bars, while the lower half shows 0% saturation. Use the resulting display for checking gray-scale tracking and chrominance-luminance timing.

Staircase Signals

A normal PAL-M 5-step modulated staircase signal is available on every active line at a fixed APL of 50% or on every fifth line with a variable APL, ranging from 10% APL to 90% APL in ten equal increments. A 10-step staircase and a Flat Field display are also available.

The staircase steps are normally modulated with 140 mV of the U component (accurately phased at 0°) of the PAL-M subcarrier. The subcarrier vector lines along the +U axis on all lines carrying the staircase signal. It may be switched off if desired. The last step of the staircase (at white level) is double width so you can view with and without subcarrier to detect clipping in the white direction.

During variable APL modes, you can add an amplitude-modulated or unmodulated V component subcarrier to the pedestal signal. Use this modulated pedestal to check chrominance-to-luminance signal distortions.

The staircase signal is particularly useful for measuring differential gain and phase, dynamic signal linearity, and luminance distortion caused by chrominance signal nonlinearity in systems under test.

GEN-LOCK REFERENCE

Input Configuration	75 Ω, loop-through
Input Requirements	
Sync Source	Nominal 1 V composite video or "Color Black with Syncs", sync negative
Sync Amplitude	300 mV, within 6 dB
Burst Amplitude	300 mV, within 12 dB
Burst/Sync Ratio	Within 6 dB
Return Loss	≥46 dB to 5 MHz
Lock-Up Sequence	Burst (Subcarrier) — Line Sync — Field Sync — PAL Phase
Acquisiton Time	
All Sequence Steps Set to:	
Slow	3 s, max
Fast	240 ms, max
Loss of Lock	Indicated by front-panel lights. Automatic switching to partial or full Internal.
Gen-locked Subcarrier Phase Error	
With Frequency Change	Within 0.5°, with input burst change of ±10 Hz.
With Temperature Change (OVEN TEMP NORMAL Light On)	Within 5°, with ambient temperature change over range of 0°C to 50°C.
	Within 1° for any 10°C increment within that range.
With Burst Amplitude Change	Within 1° with amplitude change of 210 mV to 420 mV. Within 3° with amplitude change of 75 mV to 1.2 V.
Phase Stability Breezway Effect	≤0.2° for burst including burst width variance (8-10 cycles) and breezeway variance (±0.28 μs).
Dynamic APL	≤0.1° with APL Change from 10% to 90%.
Noise Effect	Within 1° with RMS white noise at 24 dB below 700 mV (p-p) picture signal.
CHROMA PHASE Range	360° range via front panel goniometer.
LINE SYNC DELAY	
Range	Adjustable to advance 145-M sync ≥3 μs or delay ≥1 μs.
Stability	Within 70 ns over ambient temperature of 0° to +50°C.
Jitter	≤4 ns.
Field/Frame Sync	Direct-acting within 1 field. No time offset provided.

EXTERNAL REFERENCE

Input Configurations	75 Ω, loop-through.
Input Requirements	
SUBCARRIER Input	
Amplitude	1.0 to 4.0 V p-p.
Frequency	3.57561149 MHz, within 10 MHz.
Return Loss	≥46 dB to 3.57561149 MHz.
COMP SYNC Input	
Amplitude	2.0 to 8.0 V p-p.
Polarity	Negative-going.
Return Loss	≥46 dB to 5 MHz.
PAL PULSE Input	
Amplitude	2.0 to 8.0 V p-p negative-going.
Waveshape	Pulse or square wave.
Duration Pulse	≥4 μs.
Square Wave	One line between each transition.
Phasing	Internally selectable.
Pulse	Negative-going transitions with start of line sync on either a +V or −V line. Factory set to +V.
Square Wave	Positive-going transitions coincident with start of line sync on either a +V or −V line. Factory set to +V.
Return Loss	≥46 dB to 5 MHz.

Lock-Up Time	Same as Gen-Lock if all external signals are from the same source.
Loss of Lock	Indicated by front-panel lights. Automatic switching to partial or full Internal.
Subcarrier Stability	Output follows input.
LINE SYNC DELAY	Same as Gen-Lock.
CHROMA PHASE Range	Same as Gen-Lock.

INTERNAL REFERENCE (SYNC PULSE GENERATORS)

SUBCARRIER Outputs	
Frequency	3.57561149 MHz ± 10Hz.
Amplitude into 75 Ω	2 V p-p, within 10%.
Return Loss	≥30 dB.
Isolation	≥30dB.
COMP SYNC Outputs	
Output Level into 75 Ω	1 V, 2 V, or 4 V (factory-set), within 5% (Internally selectable).
Return Loss	≥30 dB.
Isolation	≥40 dB.
Timing	
Rise and Fall Time	115 ns, within 10%.
Equalizing Pulse Duration	2.33 μs, within 0.5 μs.
Equalizing Pulse Sequence Duration (First and Second)	3 H (Lines) digitally determined from 3.57561149 MHz.
Field Sync Duration	27.3 μs, within 0.2, μs.
Horizontal Sync Duration	4.71 μs, within 0.05 μs.
Field Sync Pulse Sequence Duration	3 H (lines) digitally determined from 3.57561149 MHz.
Interval Between Field Sync Pulses	4.5 μs, within 0.2 μs.
Jitter	≤ 4ns.
COMP BLANKING Output	
Output Level into 75 Ω	1 V, 2V, or 4 V (factory-set), within 5% (Internally selectable).
Return Loss	≥30 dB.
Line Blanking	
Duration	11.1 μs, within 0.25 μs.
Rise and Fall Time	115 ns within 10%.
Field Blanking Duration	21 H (1334 μs).
Rise and Fall Time	115 ns within 10%.
BURST FLAG Output	
Output Level into 75 Ω	1V, 2 V, or 4 V (factory-set), within 5% (Internally selectable).
Return Loss	≥30 dB.
Delay From Line	5.8 μs within 0.1 μs.
Rise and Fall Time	250 ns, within 50 ns.
Duration	2.5 μs, within 5%.
HORIZ DRIVE Output	
Output Level into 75 Ω	1 V, 2 V, or 4 V (factory-set), within 5% (Internally selectable).
Return Loss	≥ 30 dB.
Rise and Fall Time	115 ns, within 10%.
Timing	Leading edge coincident with leading edge of the line sync or start of line blanking (Internally selectable).
Duration	6.35 μs, within 5% (Line Sync) (factory-set) 7.9 μs, within 5% (Line Blanking).
VERT DRIVE Output	
Output Level into 75 Ω	1 V, 2 V, or 4 V (factory-set), within 5% (Internally selectable).
Return Loss	≥ 30 dB.
Rise and Fall Time	115 ns, within 10%.
Timing	Leading edge coincident with the start of the first equalizing pulse (factory set) (Internally selectable).
Duration	667.38 μs.
PAL PULSE Outputs	
Waveshapes	Pulse (factory-set) or square wave (Internally selectable).
Output Level into 75 Ω	1V, 2 V, or 4 V (factory-set), within 5% (Internally selectable).
Return Loss	≥ 30 dB.
Isolation	≥ 40 dB.
Rise and Fall Time	115 ns, within 10%.
Square wave Phasing	Negative and positive transitions occur alternately with each line sync pulse, coincident with the leading edge of line sync on either +V or −V lines. Factory-set to +V.
Duration	One line between each transition.
Pulse Phasing	Negative transition coincident with leading edge of line sync on either +V or −V lines. Factory set to +V.
Duration	4.7 μs, within 0.2 μs.
PAL FIELD 30 Hz Output	
Output Level into 75 Ω	1V, within 0.2 V.
Phasing	Positive during fields 1 and 3.
Transition Timing	3 lines prior to Field Blanking.
PAL FRAME 15 Hz Output	
Output Level into 75 Ω	1 V, within 0.2 V.
Phasing	Positive during fields 1 and 2. +V or −V phasing internally selectable. Factory set to +V.
Transition Timing	3 lines prior to Field Blanking.

COMP VIDEO OUTPUT

Amplitude into 75 Ω	1 V, p-p, made up of Chrominance, Luminance, and Sync.
Sync Component	−300 mV, within 1%, from Blanking Level.
Peak Level	+700 mV, within 1%, from Blanking Level.
Blanking dc Level	0 mV, within 100 mV.
Return Loss	≥ 30 dB.
Isolation	≥ 40 dB.
Field Period	16.67 ms digitally determined from 3.57561149 MHz.
Line Period	63.5 μs. Digitally determined from 3.57561149 MHz.
Burst	
Delay from Line Sync	5.8 μs within 0.1 μs.
Half Amplitude	2.52 μs, within 0.28 μs.
Duration of Envelope	(≈ 9 cycles).
Burst Amplitude	300 mV, within 3 %.
V Component	212 mV, within 3%.
U Component	212 mV, within 3%.
Amplitude Ratio (U/V)	1.00, within 1%.
Amplitude on Successive Lines	Smaller is 97% to 100% of the larger.
Phasing	135°, within 1°, or 225° within 1°, on successive lines. Phasing between successive bursts is 90°, within 1°.

COLOR BARS

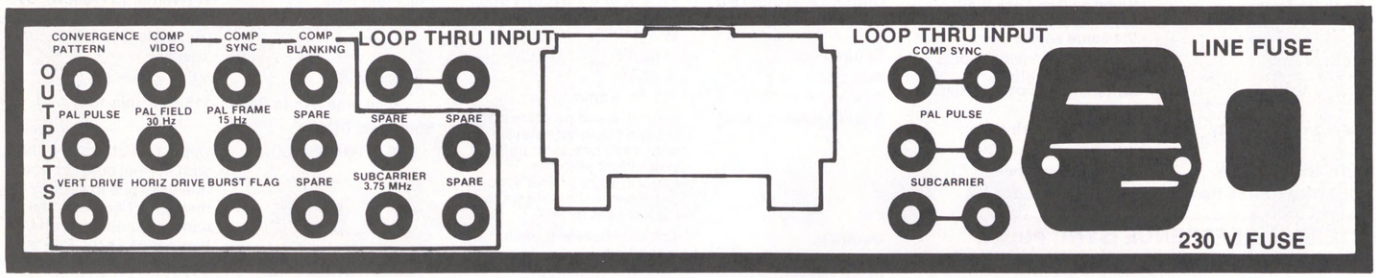
Luminance and Chrominance Component Accuracy	Absolute amplitudes of luminance signal and sync are within 1% or 1.5 mV, whichever is greater.
	Absolute amplitudes of all subcarrier frequency components (chrominance, U, V, are within 3%). Relative amplitudes of all subcarrier frequency components are within 1%, or residual subcarrier plus 1 mV, whichever is greater, of the red chrominance bar.
Full Field Bars Sequence	W (White), Y1 (Yellow), Cy (Cyan), Mg (Magenta), R (Red), Blu (Blue), Blk (Black).
Bar Width	6.6 μs within 5%.
Rise time (White Bar)	115 ns within 10%.
Split Field Displays	
COLOR BARS/RED	Upper half of display filled with normal colbr bars sequence while lower half of display is filled with the same chrominance and luminance as the Red bar.
COLOR BARS/Y REF	Upper half of display filled with normal color bars sequence while lower half displays same sequence of luminance only.
Timing	Internally selectable.
½ Field Split	Starts at line 140 (404). Factory-set.
¾ Field Split	Starts at line 200 (464).
Rise-time	375 ns within 10%.
UV Quadrature Error	≤0.5°.
V Axis Phase Switch	≤0.5°.
Residual Subcarrier	≥52 dB below 1 V at White and Blanking.
Other Spurious Outputs	≥52 dB below 1 V except 30 dB during sync and at the end of line blanking.

STAIRCASE SIGNAL

The Staircase Signal is similar to that in volume 5 of CCIR, recommendations 421-2 and 451-1, but differs in the following respect: white reference and black reference signals are provided and the subcarrier is phased to the +U axis.

Luminance Component	
Step Amplitude	
5 Steps	140 mV within 1%.
10 Steps	70 mV within 3%.
Peak Amplitude	700 mV within 1%.
Step Rise Time	260 ns within 15%.
Aberrations	Within 2%.
Step Rise Time	
Blanking Level	13.2 μs within 5%.
White Level	
5 Steps	13.2 μs within 5%.
10 Steps	9.9 μs, within 5%.
Intermediate	
5 Steps	6.6 μs within 5%.
10 Steps	3.3 μs within 5%.

145-M PAL-M



145-M/R145-M Rear Panel

U Subcarrier	
Chrominance Component	
Amplitude	
140 mV	140 mV p-p within 3%.
280 mV	280 mV p-p within 3%.
Phase	0°.
Differential Phase	
10%, 50%, 90% APL	≤0.1°.
Differential Gain	
10%, 50%, 90% APL	≤0.5%.
Subcarrier Envelope	
Rise Time	400 ns within 15%.
Duration	40 μs within 5%.
APL Pedestal	Staircase signal on every fifth line and the same line each frame.
Luminance Level Range	0 V to 700 mV within 2% in 10 equal increments.
V Subcarrier	
Chrominance Component	Alternating on 90° and 270° axes.
Unmodulated	30 mV within 5 mV.
Modulated	140 mV within 5 mV (13.2 μs).
	280 mV within 5 mV (13.2 μs).
	420 mV within 5 mV 13.2 μs).
	Incidental phase error between 280 mV and 420 mV levels, ≤0.5°.

CONVERGENCE PATTERN

Convergence Pattern	
Setup	50 mV, within 5%.
Sync Amplitude	300 mV within 5%.
Pulse Amplitude	487.5 mV within 5%.
Amplitude (Sync Tip to Pulse Peak)	837.5 mV.
Return Loss	≥30 dB.
Blanking dc Level	0 mV within 100 mV.
Crosshatch Vertical Lines	
Interval	2.7 μs.
Pulse Time Position Range	≥3.2 μs.
Pulse Polarity	Positive.
Number of Unblanked Pulses	16 to 17 (depends on POSITION control).
Crosshatch Pulse Duration	225 ns within 15%.
Dot Pulse Duration	225 ns within 15%.
Crosshatch Horizontal Lines	
Interval	17 and 18 lines alternated.
Pulse Time Position Range	≥1.4 ms.
Pulse Polarity	Positive.
Number of Unblanked Pulses	13 or 14 (depends on POSITION control).
Crosshatch Pulse Duration	1 line.
Dot Pulse Error	2 lines per frame. Digitally determined from 3.57561149 MHz.
Aspect Ratio Error	≈2%.

POWER

Mains Voltage Range	
Low	90 V to 110 V ac
115 VAC Medium	104 V to 126 V ac
High	112 V to 136 V ac
Low	180 V to 220 V ac
230 VAC Medium	208 V to 252 V ac
High	224 V to 272 V ac
Mains Frequency Range	48 Hz to 66 Hz

Factory set for 115 Vac operation.

DIMENSIONS AND WEIGHTS

(Rackmount and cabinet versions have the same dimensions and weights.)

Height	3.47 in	8,81 cm
Width	19.00 in	48.26 cm
Length	19.66 in	49.93 cm
Net Weight	20.75 lb	9.34 kg
Shipping Weight	35.0 lb	15.75 kg

ORDERING INFORMATION

When ordering please use the exact nomenclature given here.

Order 145-M PAL GEN-LOCK TEST SIGNAL GENERATOR (Cabinet).

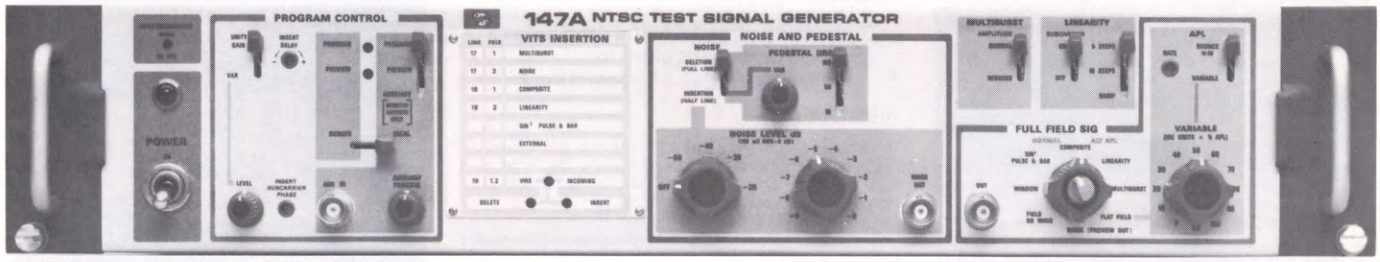
Order R145-M PAL GEN-LOCK TEST SIGNAL GENERATOR (Rackmount).

Factory set for 115 V ac operation.

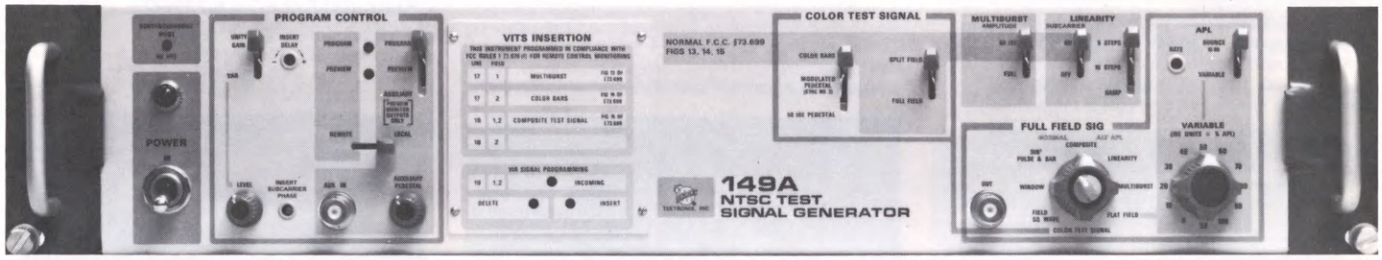
INCLUDED ACCESSORIES

75 Ω through-line termination (011-0103-02); 7½ ft, 3-wire power cord (161-0066-00).
R145-M also includes rackmounting hardware.

147A/149A NTSC GENERATORS



R147A NTSC Test Signal Generator



R149A NTSC Test Signal Generator

147A and 149A features

VITS generation, insertion, and deletion

Sync and burst regeneration

Program signal protected

Full field test signals independently selectable from the VITS program

May be reprogrammed for new signals

Vertical Interval Reference Signal

147A Unique features

Noise test signal and measurements

149A Unique features

One unit source of signals required by FCC §73-676 (f). for remote transmitter operation.

Color bars (when gen-locked to a program signal)

The 147A and 149A are similar NTSC television signal generators that supply all the test signals commonly used for test and measurement of video transmission systems. The signals generated are available as full-field composite video test signals and Vertical Interval Test Signals (VITS), which may be inserted on an incoming composite video signal.

The incoming composite video signal determines the timing information for VIT insertion. Pin connectors and internal jumpers allow modification of the test signal parameters and their time location within the vertical blanking interval. All time locations of test signals, as to position within the line and field, are derived by digital counting from a master clock, which in turn is gen-locked to the incoming synchronizing signal. Without incoming composite video (or sync), the generators will operate in the free running mode, deriving timing information from their own internal oscillator.

VERTICAL INTERVAL INSERTION/ DELETION and PROGRAM CONTROL

The 147A and 149A will insert VITS only when gen-locked to an incoming composite video signal. A VITS deleter/ inserter involves active circuit elements in the program line within the generator. Fail-safe provisions are provided in the event of a malfunction within the instrument, including loss of sync or power. Local and remote-control manual override capability are also provided.

Black burst synchronization may be selected by a remotely controlled relay. In this mode, the 147A and 149A automatically go to the program line bypass operation. Internal reprogramming cannot defeat this function.

When incoming program is lost, the 147A and 149A will go to one of two operating modes selectable by internal reprogramming jumpers. They are: program line bypass, or full field test signal, or flat field signal by jumper selector appearing at the program line output connector. In the event the program signal is lost, the transmitter will continue on the air.

A preview function lets you observe deletions and inserted signals/levels before anything is actually done to the program signal. The preview/program function can be locally or remotely controlled.

A front panel address plate provides a means for identifying the actual VITS inserted and their line and field location. Externally generated VITS may be added to the program line if desired.

PROGRAM CONTROL FEATURES

Processing Amplifier — In addition to performing deletion and insertion functions, the 147A and 149A generators are designed to function as a sync and burst regeneration amplifier.

The 147A sync and burst regeneration operating modes may be jumper selected as follows: (a) off, (b) monochrome signal — sync and burst regeneration inhibited, (c) monochrome signal — sync regeneration only. When in the regeneration mode, the 147A and 149A will not delete incoming VITS except when the 147A and 149A VITS programming takes priority.

Nonsynchronous Operation — A front panel warning light indicates absence of incoming synchronizing information without which VITS deletion or insertion is automatically discontinued.

Program Level — A front panel switch allows selection of either a preset gain, normally adjusted for unity gain between program input and program output, or front panel level adjustment to normalize the incoming program signal to provide 1 V at the program output.

Local/Remote Control of Program or Preview — Switch of program or preview modes from the front panel (local) to a remote position is controlled by connecting a remote switching circuit to a rear-panel connector. When operating under local or remote control, a light indicates preview or program status, since the front panel switch position may not indicate the actual operating mode.

Program-Preview-Auxiliary — This switch selects one of three modes:

Program — VITS inserted on program line output according to internal selection of test signals and their time address.

Preview — VITS inserted only on program as viewed on the preview monitor output. Used for verification prior to inserting these signals on program output.

Auxiliary — Permits the use of a noncomposite video signal at the auxiliary input (such as a sweep generator). This signal then appears at the monitor output connector, with composite blanking and sync added. This mode is not available by remote control.

Auxiliary Pedestal — This control provides a dc offset so that the auxiliary signal excursion may be positioned between the black and white limits of the resulting composite video signal.

VITS Subcarrier Phase — This control adjusts phase of color subcarrier on internally generated signals relative to the phase of incoming burst.

Insert Delay — This control adjusts the horizontal timing of the inserted VITS relative to the incoming synchronizing signal.

VIRS Incoming Indicator — Light indicates the presence of a Vertical Interval Reference Signal (VIRS) on incoming composite video. In this case, the generation of an internal VIRS is inhibited (inhibition may be disabled by remote control). Incoming VIRS can be observed on a suitable waveform monitor connected to the preview monitor output while internally generated VIRS are added to the opposite field. Such displays easily detect small errors in the incoming VIRS.

PROGRAM CONTROL SYSTEM SPECIFICATIONS

Input Level — Adjusted to Unity Gain.

Variable Input Level — ±30%.

Input Return Loss — <46 dB to 5 MHz. Power on, 40 dB to 5 MHz in bypass.

Output DC Level — <50 mV (no signal).

Isolation Between Program and Program Monitor Outputs — >34 dB.

Inserted Signal Level — 714 mV (100 IRE) ±1%.

Frequency Reponse, Program, and Preview Channels — ±1%, 50 kHz to 5 MHz; +1%, −5%, 5 MHz to 8 MHz.

2T Pulse to Bar Ratio — 100% ±0.5%. 100% ±0.25% for the 149A.

Field Time Tilt — <0.5%.

Line Time Tilt — <0.5%.

Differential Phase at any APL, Standard Input — Program output <0.15%. Preview output <0.3%.

Differential Gain at any APL, Standard Input — Program output <0.2%. Preview output <0.4%.

Line Time Amplitude Nonlinearity — <0.5%.

Random Noise Output Program Channel — < −75 dB rms.

Residual Subcarrier on Noninserted Lines — < −60 dB p-p.

Hum, Transients on Noninserted Lines — < −60 dB.

Spurious Signals During Blanking Time — < −40 dB.

Signal Attenuation in Delete Mode — 2T pulse > −70 dB; subcarrier (color bars) ≥ −60 dB.

Crosstalk Into Program Channel From Internal Signals — 2T pulse < −70 dB, subcarrier (color bars) < −60 dB.

Line Timing Adjustment Range With External Sync — ±0.5s.

Jitter — <5 ns.

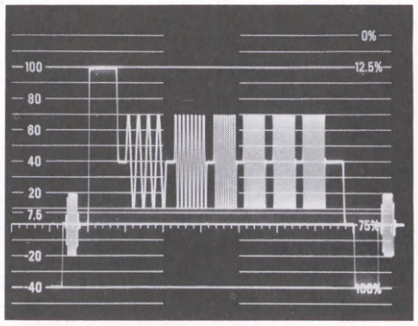
Generation, insertion and deletion of signals required for remote operation of transmitters

149A Option 1

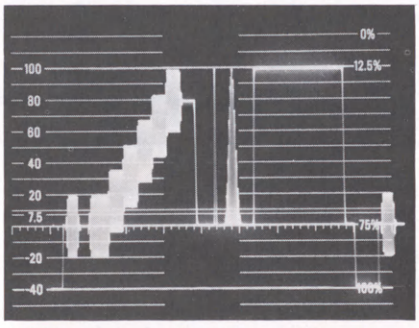
The 149A is an excellent one-unit source of the signals required for transmitter remote operation. The 149A recognizes monochrome transmissions (no burst) and includes facilities which may be used to inhibit the chrominance components of the color bar signal as required. The 149A has all the features of the 147A except Noise Test Signal.

147A Option 1

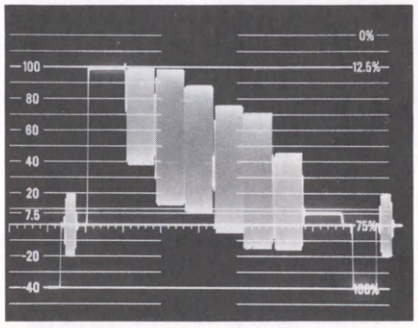
The 147A Option 1 is an alternate source of the signals required for transmitter remote control, but Color Bars must be provided from an alternate source such as the Tektronix earlier models 140, 144, 146, or the current model 1410, SPG2, TSG1.



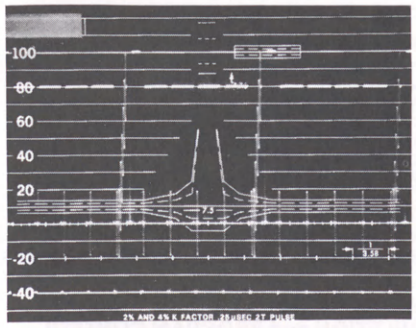
Multiburst Per FCC § 73.699.



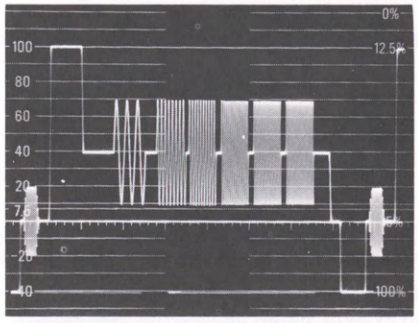
Composite Test Signal Per FCC § 73.699.



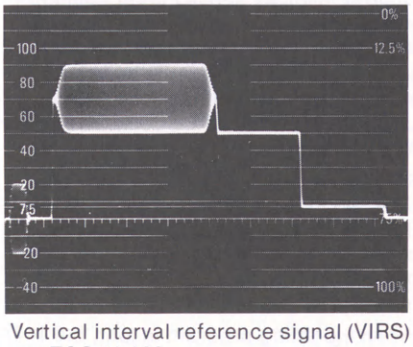
Color Bars Per FCC § 73.699.



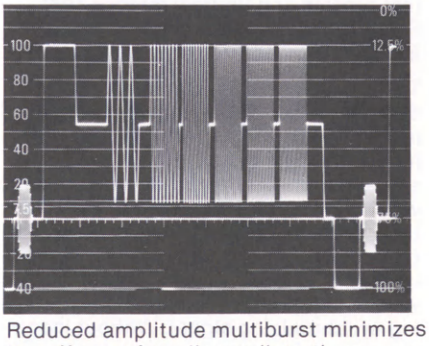
Selectable test signal and APL for monitoring distortion testing.



Full amplitude multiburst.



Vertical interval reference signal (VIRS) per FCC 73.699.



Reduced amplitude multiburst minimizes the effects of nonlinear distortions.

VERTICAL INTERVAL REFERENCE SIGNAL

The VIR signal is generated and inserted by the generator on line 19 of both fields. The generator is programmable for many possible operating modes depending upon the presence or absence of a VIR signal on the incoming program line.

Indicator lamps show the presence of an incoming VIR signal, whether an incoming VIR is being deleted, and whether a local VIR is being inserted. Remote control is also available for VIR signal functions with the front panel indicators showing the actual operating mode.

If the program signal is monochrome, the 147A and 149A may be programmed (internal jumper) to either stop or continue inserting VIRS. This feature is useful if VIRS-dependent automatic correction devices (such as the Tektronix 1440) are being used.

FIELD SQUARE WAVE

The Field Square wave signal provides a sensitive means for measuring field time distortions. In this mode, the 147A and 149A provide a composite video signal with 170 active lines at 100 IRE, which approximates a 60 Hz square wave. This composite video signal reveals low-frequency phase and gain distortions as a simple 60 Hz square wave will do, but unlike the latter, it can pass through clamper amplifiers.

Amplitude — Within ± 1 IRE of white reference.

Number of White Lines — 57 through 227 on each field. All remaining active lines are black.

Rise Time — Shaped by $\sin^2$ filter with first zero in frequency domain at 4 MHz.

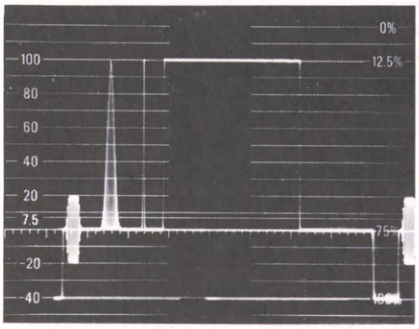
MULTIBURST SIGNAL

The Multiburst Signal is generated by a function generator controlled by the digital programmer. This approach eliminates the need for individual start/stop oscillators for each burst, and for individual amplitude and ac axis adjustments for each burst. Each burst start time is completely stable, and each burst consists of an exact integer number of cycles, regardless of the frequency. They start at 0° of the first cycle and end at 360° of the last cycle. Location of the white flag may be programmed with relation to the bursts and used for source identification.

White Reference Amplitude — 100 IRE ± 1 IRE.

Burst Amplitude — Normal amplitude: 90 IRE plus 10 IRE setup. Reduced amplitude: 60 IRE plus 10 IRE setup, or 50 IRE with no setup.

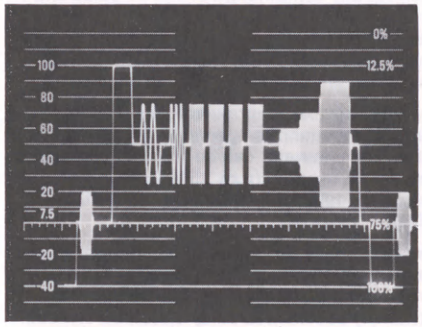
Average Burst Level — 55 ± 1 IRE with 10% setup. Reduced, 40 ± 1 IRE with 10% setup.



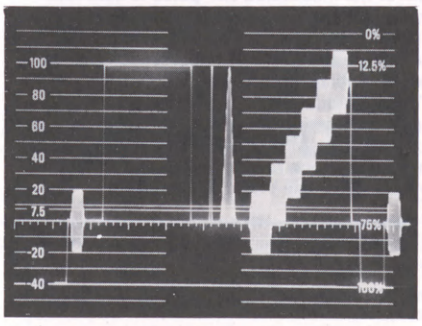
2 T pulse with 12.5 T modulated pulse and bar.

INTERNATIONAL INSERTION TEST SIGNALS (149A Option I)

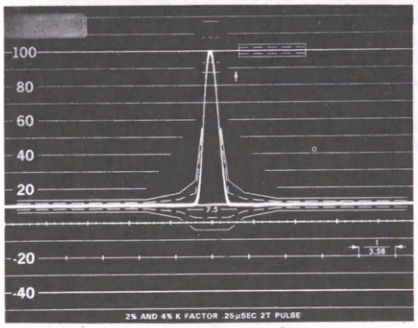
The 149A Option 01 is factory programmed to provide the two International Insertion Test Signals (ITS) for 525 line/60 field systems (per CCIR recommendation 473-2, Annex II). The signals are inserted on line 17, fields 1 and 2.



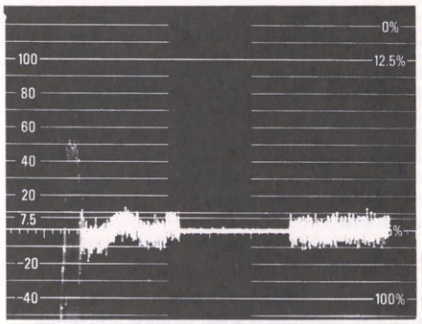
Line 17, Field 2 (149A Option 01 only). Combination VITS per CCIR recommendation 473-2, Annex II.



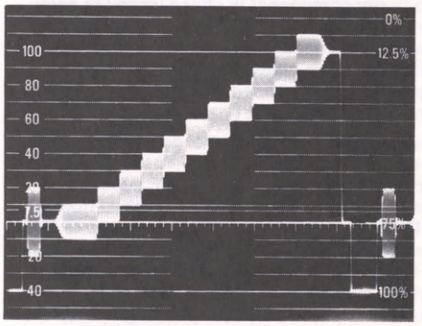
Line 17, Field 1 (149A Option 01 only). Composite VITS per CCIR recommendation 473-2, Annex II.



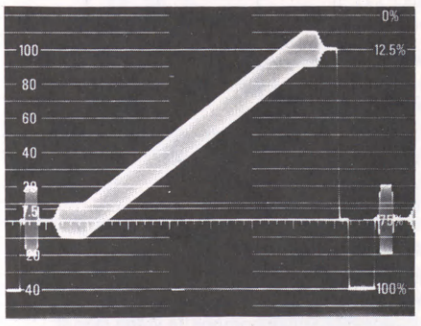
2 T pulse with T bar double exposed.



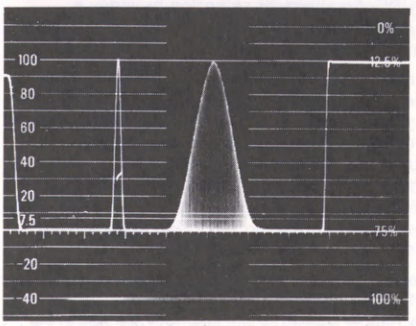
Noise test with inserted noise in center of line. Inserted noise is adjusted low for identification of time location. 147A only.



Linearity test signal — 10 step with 20 IRE subcarrier at burst phase.



Linearity test signal — ramp; 0 to 100 IRE with 20 IRE subcarrier in phase with burst.



2 T pulse with 12.5 T modulated pulse and bar. Subcarrier is phase modulated at field rate.

147A/149A NTSC GENERATORS

COLOR BARS (149A Only)

The 149A, when gen-locked to a program signal, provides either full-field or split-field color bar signals selectable by a front panel switch. This split-field signal is used to show gray scale tracking and consists of the luminance component of color bars on all active lines. The chrominance component is added to lines 66 through 218.

LINEARITY SIGNAL

Three linearity test signals are selectable with front-panel controls: 5 step, 10 step, and ramp; either modulated or unmodulated. The luminance component is selectable at either 10 equal 10-IRE step, 5 equal 16-IRE step, or a 100-IRE ramp. Each of these is internally adjustable from 80-100 IRE peak amplitude. The subcarrier component is phase-locked to color burst. You can use these signals for measurement of differential gain and phase, dynamic gain, luminance signal linearity, luminance signal distortion caused by chrominance signal nonlinearity, and burst phase errors.

Measurements of differential gain and phase can be made more easily with 40 IRE subcarrier to override noise than with 20 IRE subcarrier. The subcarrier amplitude can be varied from 20 to 40 IRE by internal selection. Since the 40 IRE level of subcarrier should not be used together with full amplitude staircase or ramp where the test signal may be radiated, luminance amplitude of modulated linearity signals can be reduced to 80 IRE by internal adjustment.

Luminance Component — Peak amplitude: 100 IRE within 1%. Each step is 20 IRE, within 1%, in 5 step and 10 IRE in 10 step. Step rise time: 230 ns. Aberrations: within 2%. Step durations: 6 μs for 5 steps, 3 μs for 10 steps.

Chrominance Component — Amplitude: 286 mV p-p (40 IRE) within 5% and in phase with burst. (Can be 143 mV 20 IRE with internal jumper change.)

Differential Phase — $\leq 0.2°$.

Differential Gain — $\leq 0.5\%$.

Subcarrier Envelope — Rise time: 375 ns.

Ramp Luminance Amplitude — 714 mV, 100 IRE $\pm 1\%$.

Ramp Linearity — Within 1%.

Ramp Duration — 40 μs.

FLAT FIELD SIGNAL

The Flat Field signal with VITS inserted is used primarily for system testing at discrete average picture levels. It is a composite video signal which has a constant luminance level during the active portion of each field.

The luminance level of the Flat Field signal is selectable in 10 IRE unit increments from 0 to 100 IRE. An alternate selection provides a bounce between 10 and 90 IRE at a 0.1 to 1.0 Hz rate.

An added feature combines flat field and one other selectable test signal, i.e., color bar (149A only), multiburst, pulse and bar, linearity, and composite. This mixed test signal provides a brighter waveform monitor display (than VITS and flat field) by alternating four lines of the variable flat field pedestal with one line of the selected other test signal during each active field.

Luminance Level — Within 2% of the indicated level except the 100 IRE level which is within 1%.

Rise Time — Shaped by $\sin^2$ filter with first zero in the frequency domain at 4 MHz.

PULSE AND BAR SIGNAL

Two 9 pole Kastelein filters generate highly precise 2T and T pulses. The digital programmer provides the high timing accuracy required in these pulses to eliminate jitter and long term drift. The programmer also determines exact signal element-to-element spacing and bar duration. It may be readily reprogrammed, in 2 μs increments, to produce different spacings or bar widths.

The $\sin^2$ pulse may be either 2T (0.25 μs HAD) or T (0.125 μs HAD). The transitions of the bar are also controlled by either of the two Kastelein filters so that frequency spectrum is limited to 4 MHz or 8 MHz. Shape of these transitions is integrated $\sin^2$.

For specific applications, you may program the 147A for any combination of T or 2T pulse and T or 2T bar. As shipped, the pulse is 2T, and the bar is formed by the T filter. Thus the pulse and bar test signal is useful for measuring line time and short time distortions.

The envelope of the modulated $\sin^2$ pulse is formed in the function generator rather than in a filter. This generator can be programmed for any desired pulse width from 1.5 to 2.5 μs, offering unique modulated $\sin^2$ pulse generator flexibility.

The modulated $\sin^2$ pulse (12.5T) is used in measuring relative gain and delay errors between chrominance and luminance signals. It is extremely sensitive to delay distortion and easily used, as delay distortion equals 10 d, where d equals baseline sinusoidal ripple in percent. The 20T pulse is also available.

As a full field test signal, the subcarrier component of the modulated $\sin^2$ pulse is field rate phase modulated, resulting in a completely filled in modulated $\sin^2$ pulse envelope. This feature greatly simplifies the measurement of gain and delay distortions. When used as a VITS, the modulated $\sin^2$ pulse has a programmable phase offset between its subcarrier component and color burst. This offset may be used as a source code to identify the point in the system where the VITS are inserted.

2T Pulse Amplitude — Within 1 IRE of T Bar.

2T HAD — 250 ns within 7.5 ns.

2T Ringing — Amplitude <0.5 IRE; duration <4 cycles.

Time Location — Internally programmable in 2 μs increments.

T Bar Amplitude — 714 mV (100 IRE) $\pm 1\%$.

T Bar Rise Time — 115 ns $\pm 15\%$.

T Bar Time Location — Start and stop internally programmable in 2 μs increments.

12.5T Modulated Pulse Peak Chrominance to Peak Luminance Amplitude Difference — <0.5 IRE.

12.5T Modulated Pulse HAD — 1.57 μs or can be internally set to 2.5 μs 20T, if desired.

T Modulated $\sin^2$ Pulse Residual Subcarrier — <0.5 IRE on insertion line.

T Modulated $\sin^2$ Pulse Relative Chroma-Luminance Time Delay — <10 ns.

WINDOW SIGNAL

The Window signal is the same as the Pulse and Bar except that the Window occupies lines 66 through 218 only. It is sensitive to both line time and field time distortions and is especially useful in evaluating picture monitors. Where field rate distortion is present, the Window signal will be more affected than the Pulse and Bar.

Amplitude — 100 IRE within 1 IRE.

Rise Time — Internally programmable: either 2T pulse and T Bar, or T pulse and 2T bar.

Window Duration — Lines 66 through 218.

COMPOSITE TEST SIGNAL

The Composite Test signal is a multiple function signal suitable for use as a VITS or as a full field signal. The multiple elements of this signal, avialable in both NTC7 and FCC formats, meet a wide variety of testing needs. Phase of the subcarrier of the modulated 20T pulse may be used to identify the VITS insertion point.

NOISE TEST SIGNAL (147A only)

The 147A offers a signal-to-noise measuring technique for in-service testing during the vertical interval. The noise present in the middle portion of a line is deleted while the noise generated in a calibrated source is inserted for measurement by comparison. You then adjust the calibrated attenuator until inserted and incoming noise appear the same on a waveform monitor. The measured noise values are independent of operator interpretation errors to within 2 dB.

Point-to-point transmission noise may be measured using multiple 147As. At the origination point, use a 147A in the delete mode to provide a quiet reference line. Further down the transmission system, use a second 147A to match the noise level. You may repeat this process and determine the transmission noise level for individual sections as well as overall performance of the transmission system. Noise may be measured at 10, 50, or 100 IRE luminance levels. The calibrated noise generator provides "flat" (white) noise.

External filters are required with the 147A when making noise measurements.

Noise Pedestal Amplitude — Selectable 10, 50, or 100 IRE within 0.2 dB.

Variable Pedestal — Provided.

Noise Levels — -20 dB to -59 dB in 1 dB steps (0 dB = 700 mV RMS).

Flat Noise Spectrum — Energy unit bandwidth: 15 kHz to 5 MHz ± 6 dB. (Spectrum extends well beyond 5 MHz.)

Output Impedance — 75 Ω.

Return Loss — ≥ -30 dB to 5 MHz.

Important — External filters are required for low pass filtered and weighted noise measurements.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 1 BEAVERTON, OR

POSTAGE WILL BE PAID BY ADDRESSEE

Tektronix, Inc.
Attn: James Buchanan
P.O. Box 1700
Beaverton, OR 97075

TV PRODUCTS MAIL LIST DATA ENTRY FORM

TV 1980

Mr. ☐ Ms. ☐ Mrs. ☐ Miss ☐ Prof. ☐ Dr. ☐

(16) Phone (_____) _____ Ext _____ Date _____

(06) Name & Title _____

(07) Dept./Mail Station _____

(08) Company _____

(09) Address _____

(10) City/State _____

City Cdn Prov (11) State (12) Cdn (13) Zip Code (14)

TEKTRONIX USE ONLY

☐ Add ☐ Change ☐ Delete

(01) Record No. _____ (Change Delete Only)

(02) Firm No. _____

Mailing Address: ☐ Company

☐ Company, different street address

☐ Home ☐ Other _____

(47) Catalog ☐ Yes ☐ No

(03) P.O. No. _____ (28) K M ☐

(40) Territory No. _____

Complete the form by marking your interests in the spaces provided. For example, if the company, or department, is primarily involved in Broadcasting as a Network Affiliate then mark the corresponding box boldly.

1.

My company, or department, is primarily involved in the following ONE area: (20)

- ☐ 70. Broadcasting (Network)
- ☐ 71. Broadcasting (Network Affiliate)
- ☐ 72. Broadcasting (Group)
- ☐ 73. Broadcasting (Independent)
- ☐ 74. Common Carrier
- ☐ 75. CATV
- ☐ 76. Production (Corporate)
- ☐ 77. Production (Commercial)
- ☐ 78. Production (Educational)
- ☐ 79. Production (Medical)
- ☐ 80. Production (Religious)
- ☐ 81. Production (Government)
- ☐ 82. Television Systems Manufacturing
- ☐ 83. Original Equipment Manufacturing
- ☐ 84. Tape or Disc Duplication
- ☐ 85. Research
- ☐ 86. Equipment Rental

2.

My work is best described by the following ONE category: (18)

- ☐ 4. General Management
- ☐ 5. Technical Operations
- ☐ 6. Technical Operations, Management
- ☐ 7. Production
- ☐ 8. Production Management
- ☐ 9. Engineering
- ☐ 10. Engineering Management
- ☐ 11. Maintenance
- ☐ 12. Maintenance Management
- ☐ 13. Manufacturing
- ☐ H. Sales/Marketing
- ☐ I. Consulting
- ☐ B. Purchasing

3.

Please check your other Product Interests: (25)

- ☐ 1. Oscilloscopes
- ☐ 4. Computer Terminals, Desktop Graphic Computers, and other Computer Peripherals
- ☐ 6. Tekscope (a bimonthly publication providing useful information on Tektronix products and their application).
- ☐ 14. Modular Test Instruments
- ☐ 26. Logic Analyzers
- ☐ 35. Spectrum Analyzers

Just fold with Business Reply Face showing and mail, no tape or staples, please.

4.

If your company or department produces television programs or advertising, check the appropriate item(s) in EACH category: (45)

A. PRODUCTION FORMAT

- ☐ A. ½" Video Tape
- ☐ B. ¾" Video Tape
- ☐ C. 1" Video Tape
- ☐ D. 2" Video Tape
- ☐ E. Film

B. PROGRAM DISTRIBUTION

- ☐ F. ½" Video Tape
- ☐ G. ¾" Video Tape
- ☐ H. 1" Video Tape
- ☐ I. 2" Video Tape
- ☐ J. Film
- ☐ K. Video Disc
- ☐ L. Satellite

C. TELEVISION STANDARD

- ☐ M. NTSC
- ☐ N. PAL
- ☐ O. SECAM
- ☐ P. OTHER

I would like to receive:

☐ Annual General Catalog. (47)

Tektronix®
COMMITTED TO EXCELLENCE

Use this card to add your name to the TEKTRONIX Television Mail List. Please fill out the card completely to receive information related to your work.

Use these cards to receive information or assistance. Allow 35 days for response.

☐ Please send me General Catalog **TV 1980**

☐ Please call me about:

☐ Please send information on:

Please Print or Type

Name _____ Phone _____

Station or Company _____

Street _____

City _____ **State** _____ **Zip** _____

☐ Please send me General Catalog **TV 1980**

☐ Please call me about:

☐ Please send information on:

Please Print or Type

Name _____ Phone _____

Station or Company _____

Street _____

City _____ **State** _____ **Zip** _____

☐ Please send me General Catalog **TV 1980**

☐ Please call me about:

☐ Please send information on:

Please Print or Type

Name _____ Phone _____

Station or Company _____

Street _____

City _____ **State** _____ **Zip** _____

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 1 BEAVERTON, OR

POSTAGE WILL BE PAID BY ADDRESSEE

Tektronix, Inc.
P.O. Box 1700
Beaverton, OR 97075

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 1 BEAVERTON, OR

POSTAGE WILL BE PAID BY ADDRESSEE

Tektronix, Inc.
P.O. Box 1700
Beaverton, OR 97075

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

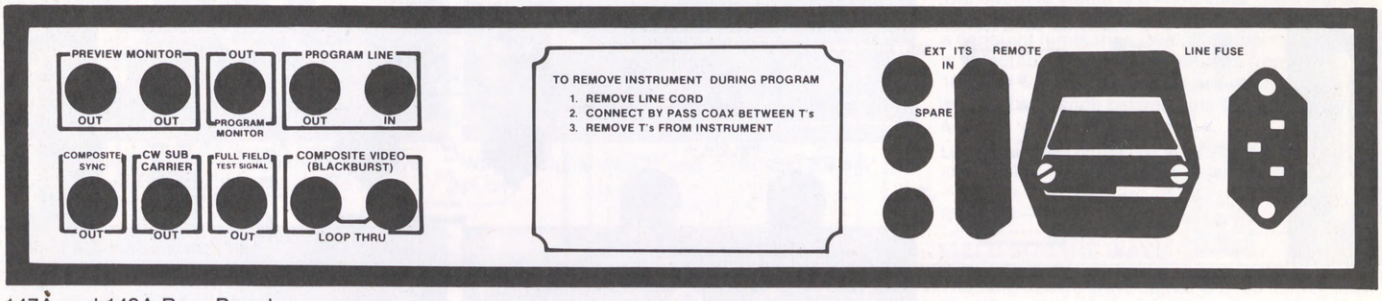
BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 1 BEAVERTON, OR

POSTAGE WILL BE PAID BY ADDRESSEE

Tektronix, Inc.
P.O. Box 1700
Beaverton, OR 97075

147A/149A NTSC GENERATORS



147A and 149A Rear Panel

NOISE MEASUREMENT FILTERS

External filters are required with the 147A Generator when making noise measurements. For systems using 525/60 standards **order 015-0212-00 Low Pass Filter and 015-0214-00 Noise Weighting Filter. Order 015-0212-00 Low Pass 4.2 MHz 525/60. Order 015-0214-00 Noise Weighting 4.2 MHz 525/60.**

CCIR recommendation 568 provides for measuring signal-to-weighted random noise on all international transmissions (both 525/60 and 625/50) with a 5.0 MHz low pass filter and a unified noise weighting filter. **Order: 015-0213-00 Low Pass 5 MHz. Order: 015-0283-00 Unified Noise Weighting.**

OTHER CHARACTERISTICS

Power Requirements — 90 to 136 Vac or 180 to 272 Vac, 48 Hz to 66 Hz, 40 W max at 115 Vac and 60 Hz. Rear panel selector provides rapid accommodation for 6 line-voltage ranges. (Shipped set at 115 Vac.)

Inputs — External VITS Inputs, Program Input, Auxiliary Input, Composite Sync, and Subcarrier.

Output — Program Monitor, Preview Monitor (two each), and Full Field.

Ambient Temperature — Performance characteristics are valid over an ambient temperature range of 0° to +50°C.

DIMENSIONS AND WEIGHTS

	Cabinet		Rackmount	
	in	cm	in	cm
Height	3.875	9.9	3.5	8.9
Width	17.875	45.5	19.0	48.3
Length	17.875	43.6	17.875	43.6
	lb	kg	lb	kg
Net	19.0	8.9	20.0	9.1
Domestic Shipping	35.0	15.9	36.0	16.3
Export Shipping	55.0	25.0	56.0	25.4

ORDERING INFORMATION

When ordering please use the exact nomenclature given here.

147A NTSC Signal Generator

R147A NTSC Signal Generator (Rackmount)

147A Option 01 NTSC Signal Generator

R147A Option 01 NTSC Signal Generator (Rackmount)

149A NTSC Signal Generator

R149A NTSC Signal Generator (Rackmount)

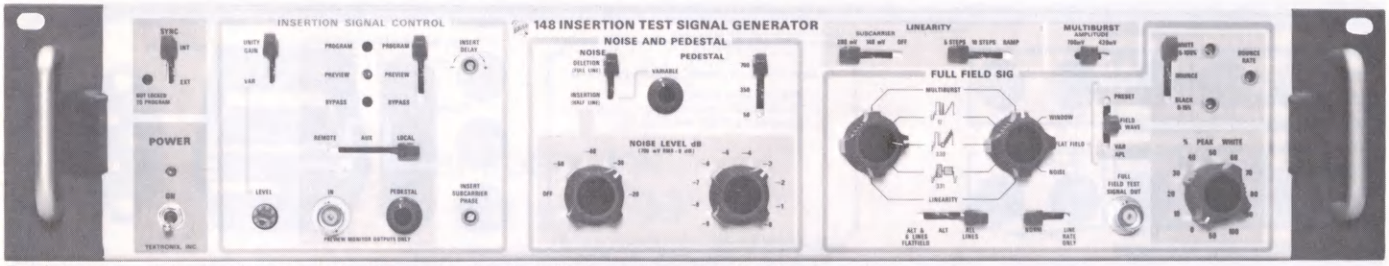
149A Option 01 NTSC Signal Generator

R149A Option 01 NTSC Signal Generator (Rackmount)

INCLUDED ACCESSORIES

75 Ω, BNC termination (011-0103-02); 2 each BNC-T adapters (103-0030-00); 7½ ft. power cable, three wire (161-0036-00); VIT program clear plastic cover plate (200-1474-00); Front panel protective cover (200-1328-00); R147A and R149A include rackmounting hardware.

148 INSERTION TEST SIGNAL GENERATOR



Rackmount version; cabinet version has carrying handle less mounting hardware.

Insertion Test Signals (per EBU, CCIR recommendation 473-2, Annex I)

Full-Field Test Signals (per CCIR recommendation 567)

Easily Reprogrammable

Safe In-Service ITS Insertion (per EBU specifications)

Noise Measurement Width

APL Bounce Signal

Source Identification Code

Operates With Sound In Syncs

Locks With Mixed Syncs (per EBU homologation specifications for I.T.S. generators)
- **Subcarrier**
- **PAL pulse**
- **Burst flag**

The Tektronix 148 Insertion Test Signal (ITS) Generator provides all the test signals you need to test and measure PAL video transmission systems. Test signals are available as both full-field composite video and ITS inserted into the incoming program signal's vertical blanking interval. All timing information for ITS insertion is derived from the incoming composite video signal.

Internal pin connectors permit you to modify test signals and their field and line locations within the vertical blanking interval. Test signal time locations within the line and field are derived digitally from a master clock gen-locked to the incoming synchronizing signal. In the absence of incoming sync, the 148 will continue to operate in the free-running mode, deriving timing information from its internal oscillator.

VERTICAL INTERVAL INSERTION/DELETION AND PROGRAM CONTROL

The 148 inserts ITS only when gen-locked to an incoming composite video signal. Since ITS insertion/deletion involves active circuit elements in the program line, program line fail safe operation is provided in the event of instrument malfunction, loss of sync, or power failure. You also have access to local and remote control manual override capability.

A preview monitor output permits observation of the ITS deletion/insertion program before anything is actually done to the program signal. Preview/program operation can be locally or remotely controlled.

Provisions are made for adding an externally generated ITS to the program line.

INSERTION SIGNAL CONTROL FEATURES

Free Running Operation — A warning light indicates absence of incoming synchronizing information, and ITS deletion and insertion is automatically discontinued.

Program Level — A front panel switch lets you select a preset gain, normally adjusted for unity gain between program input and program output. Or, you can use a front panel level adjustment to normalize the incoming program signal to provide 1 V at the program output.

Local-remote Control of Program and Preview — You can shift control of program or preview modes from the front panel (local) to a position remote from the 148. When operating under either local or remote control, front panel lights indicate program line status, since the front panel program status switch position may not correspond to the operating mode selected.

Program-Preview-Bypass — This switch selects one of three modes:

Program — ITS inserted on program line output according to internal selection of test signals and their time addresses.

Preview — ITS inserted only on program as viewed on the preview monitor output; used for verification prior to inserting these signals on program output.

Bypass — Incoming program material bypasses 148 functions and is outputted unchanged.

Auxiliary — A noncomposite video signal (such as a sweep generator) applied to the auxiliary input appears at the preview monitor output connector with composite blanking and sync added. A pedestal control provides a dc offset so the auxiliary signal excursion may be positioned between the black and white limits of the resulting composite video signal. Remote control is not available.

ITS Subcarrier Phase — A recessed front-panel control adjusts phase of color subcarrier on internally generated signals to be correct in relation to the phase of incoming burst.

Insertion Delay — A recessed front-panel control provides a fine horizontal timing adjustment for inserted signals.

PROGRAM CHANNEL SPECIFICATIONS

Input Level — Adjusted to Unity Gain.

Variable Input Level — ±30%.

Input Return Loss — ≥ 30 dB to 7 MHz.

Output DC Level — < 50 mV (no signal).

Isolation Between Program Preview Outputs — ≥ 46 dB to 5 MHz.

Isolation Between Program and Program Monitor Outputs — ≥ 34 dB to 5 MHz.

Inserted Signal Level — Within ±1% of nominal.

Frequency Response, Program, and Preview Channels — ±1%, 50 kHz to 5 MHz. +1%, −5%, 5 MHz to 8 MHz.

2T Pulse to Bar Ratio — Within 0.25%.

Field Time Tilt — <0.5%.

Line Time Tilt — <0.25%.

Differential Phase at any APL, Standard Input — Program output < 0.15°. Preview output < 0.3°.

Differential Gain at any APL, Standard Input — Program output < 0.2%. Preview output < 0.4%.

Line Time Amplitude Nonlinearity — < 0.5%.

Random Noise Output Program Channel — < −75 dB RMS.

Residual Subcarrier on Noninserted Lines — ≤ 0.7mV.

Hum, Transients on Noninserted Lines — ≥ 60 dB down.

Spurious Signals during Blanking Time — Inactive line time ≥ 40 dB down. Active ITS lines ≥ 60 dB.

Signal Attenuation in "Delete" Mode — 2T pulse > −70 dB. Subcarrier (color bars) > −60 dB.

Crosstalk into Program Channel from Internal Signals — 2T pulse < −70 dB, subcarrier (color bars) < −60 dB.

Unwanted Pedestal at Time of ITS Insertion — Program and Preview Channel. < 5 mV.

Insert Delay Adjustment Range — ±0.5 μs front panel.

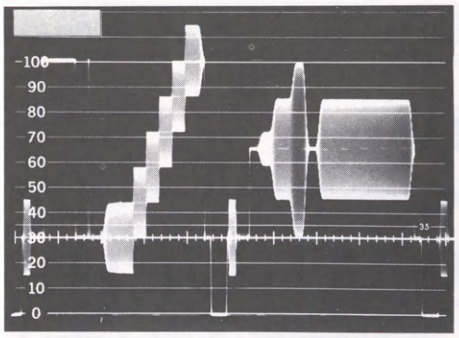
FULL-FIELD OPERATION

The Tektronix 148 provides full-field test signals separate from program. These signals are generated with or without external synchronizing information and will be locked to the external synchronizing signal when a program signal or external synchronizing signals are present.

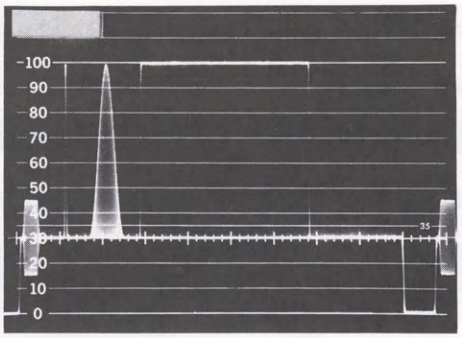
Full-field signals available include: Multiburst, Linearity, Flat Field, Window, Noise, Line 17, Line 330, and Line 331. Select these eight signals using two switches that permit any one of the signals to be produced on all active lines. You can also designate that any two signals be alternated on all active lines, or any two signals be paired on two successive lines and then alternated with six lines of adjustable flat field.

When operating the 148 in the flat field mode, you may select a white level preset between 85% and 100% and a black level preset between 0% and 15%. Automatic change between white and black is available and occurs at a period adjustable from 1.0 s to 10.0 s.

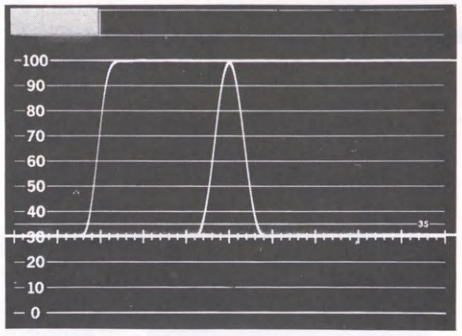
Eleven APL levels between 0% and 100% of white can be used in the flat field or alternation mode. In the alternation mode, flat field lines are alternated with other selected signals, such as multiburst or linearity.



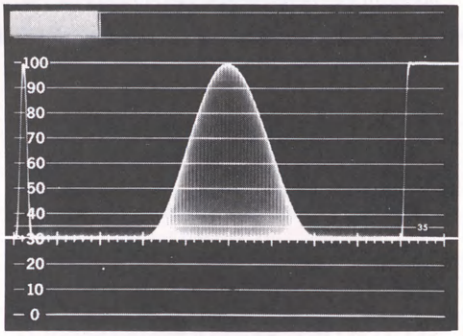
Full-field alternation of two signals on all active lines (CCIR recommendation 569, figure 3).



Window signal with 2T and modulated 20T sin² pulses.



2T sin² pulse superimposed on bar by double exposure.



Modulated 20T pulse magnified.

All full-field signals are available with or without vertical sync and blanking selectable from the front panel.

PULSE AND BAR SIGNAL

Highly precise 2T and T pulses are generated by two 9 pole Kastelein Filters. The 148's digital programmer provides the high degree of timing accuracy required to eliminate jitter and long term drift. This programmer also determines exact signal element-to-element spacing and element duration. The programmer is adjustable in 2 μs increments.

The sin² pulse may be either 2T (200 ns HAD) or T (100 ns HAD). The transitions of the bar are controlled by either Kastelein Filter, and frequency spectrum is limited to 5.0 MHz or 10.0 MHz. The shape of these transitions is integrated sin².

For a specific application, you may program the 148 for any combination of T or 2T pulse and T or 2T bar. As shipped, the pulse is 2T, and the bar is formed by the T filter to provide for K factor meaurements of short time distortion. The pulse and bar test signal provides a means for measuring line time and short time distortions.

The envelope of the modulated sin² pulse is formed by a 9 pole Kastelein filter located on a separate plug-in circuit board. This allows you to obtain different pulse durations with the use of other filters.

The modulated sin² pulse (20T) is used in measuring relative gain and delay errors between chrominance and luminance signals. The 20T modulated sin² pulse has a 2.0 μs HAD. Greater sensitivity to chrominance-luminance delay errors may be obtained by using reduced pulse width.

2T Pulse Amplitude — Within 1% of luminance bar.

2T HAD — 200 ns.

2T Ringing — Amplitude < 0.5%; duration < 2 cycles.

Time Location — Internally programmable in 2 μs increments.

Luminance Bar Amplitude — 700 mV ± 1%.

T Bar Rise Time — 100 ns ± 15%.

T Bar Time Location — Start and Stop internally programmable in 2 μs increments.

20T Modulated Pulse Peak Chrominance to Peak Luminance Amplitude Difference — < 3 mV.

20T Modulated Pulse HAD — 2.0 μs.

20T Modulated Pulse Residual Subcarrier — <3 mV on insertion line.

20T Modulated Pulse Relative Chroma-Luminance Time Delay — < 5 ns.

WINDOW SIGNAL

The window signal is the same as the pulse and bar except that it occupies the center 205 lines of each field. This signal lets you measure both line time and field time distortions, and is especially useful for observing picture monitors. Where field rate distortion is present, the window signal will be affected to a much greater extent than the pulse and bar signal.

Amplitude — 700 mV.

Rise Time — Internally programmable at either 2T pulse and T window, or T pulse and 2T window.

LINEARITY SIGNAL

You can select three Linearity Test Signals: 5 step, 10 step, or ramp (either modulated or unmodulated). The subcarrier component is phase-locked to color burst. Use this signal for measuring differential gain and phase, dynamic gain, luminance signal linearity, luminance signal distortion caused by chrominance signal nonlinearity, and burst phase and amplitude errors.

Luminance Component — Peak amplitude 700 mV within 1%, 5 step, 10 step, or ramp.

Riser Shape — Sin² shape with a nominal 200 ns risetime.

Chrominance Component — Amplitude is selectable at 0 mV, 140 mV, or 280 mV.

FLAT-FIELD SIGNAL

The flat-field signal with VITS inserted is used primarily for system testing at discrete average picture levels.

148

The flat-field signal is a composite video signal that, during the active portion of each field, has a constant luminance level. The luminance level is selectable in eleven increments from 0% to 100% of white. An alternate selection provides automatic change between black and white with a period variable from 1 to 10 s.

Luminance Level of The Flat Field Signal — Within 2% of the indicated level, except the 100% level, which is within 1%.

Rise Time — 200 ns.

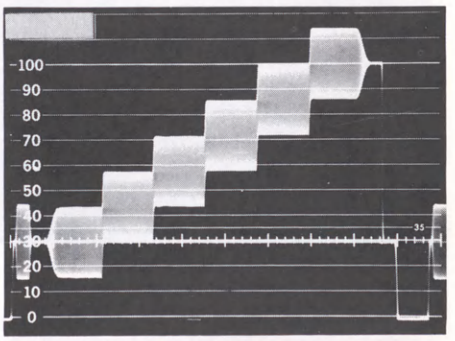
FIELD SQUARE WAVE

The field square wave signal is used to measure field time distortions. In this mode, the Tektronix 148 provides a composite video signal with 205 active lines at 700 mV, approximating a 50 Hz square wave. Use this signal to detect low frequency phase and gain distortions, even those passing through clamper amplifiers.

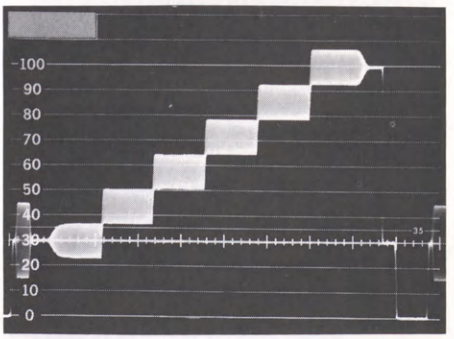
Amplitude — Within ± 1 mV of white reference.

Number Of White Lines — 65 through 270, and 377 through 582. All remaining active lines are black.

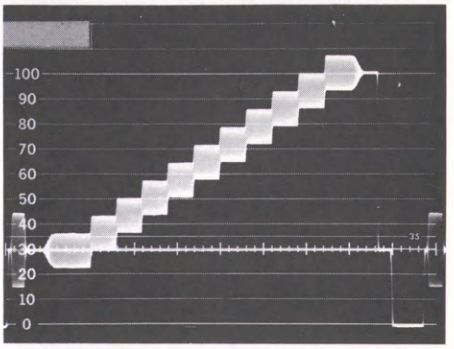
Rise Time — 200 ns.



Linearity signal, 5 step, 280 mV subcarrier.

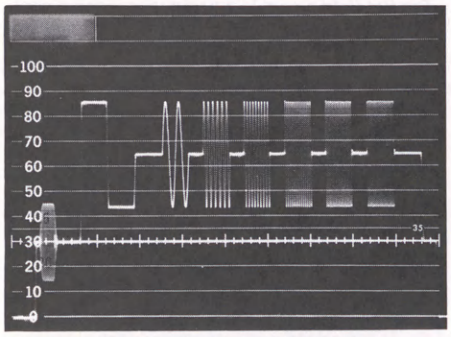


Linearity signal, 5 step, 140 mV subcarrier.

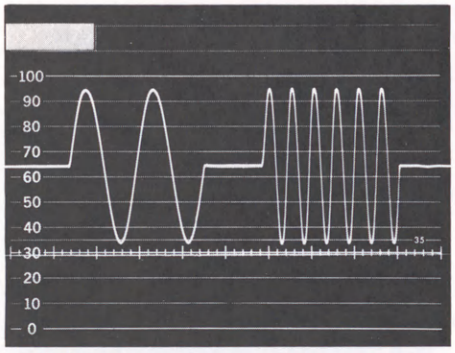


Linearity signal, 10 step, 140 mV subcarrier.

148 INSERTION TEST SIGNAL GENERATOR



420 mV Multiburst. Notice burst starts and stops precisely at the same level.



Multiburst magnified to show start/stop transitions.

MULTIBURST SIGNAL

The multiburst signal is generated by a function generator controlled by a digital programmer. This design eliminates the need for individual start/stop oscillators on each burst and individual amplitude and ac axis adjustments. Each burst start time is completely stable, and each burst packet consists of an exact number of cycles, regardless of the frequency. Each burst starts at 0° of the first cycle and ends at 360° of the last cycle. Location of the white flag with relation to the bursts is programmable and may be used for source identification.

White Reference Amplitude — 700 mV ±1% and 420 mV ±1%.

Burst Amplitude — Amplitude selectable at normal or reduced. Internal adjustment presets normal amplitude value.

Burst Frequencies — 0.5, 1, 2, 4.0, 4.8, and 5.8 MHz within 3%. Each burst frequency is independent and internally adjustable.

Timing — Each burst starts at 0° of the first cycle and ends at 360° of the last cycle.

NOISE

The 148 offers a unique signal-to-noise measuring technique for in-service testing during the vertical interval. The noise present in the middle portion of an internally selected line is deleted, and noise generated by a calibrated source is inserted for comparison. You can vary a calibrated attenuator until inserted noise and incoming noise appear the same on a waveform monitor. The noise values measured are independent of interpretation errors to within 2 dB.

When measuring transmission noise, you may delete the noise on an entire line at the point from which the noise is to be measured using one 148. Further down the transmission system, you can use a second 148 to match the noise level in the manner described previously. Repeat this process to determine the transmission noise level for several sections of the transmission system.

Noise may be measured at 50 mV, 350 mV, or 700 mV luminance levels. The calibrated noise generator provides flat (white) noise. External noise filters are required with the Tektronix 148 when making noise measurements.

Noise Pedestal Amplitude — 50 mV ± 5 mV, 350 mV within 2%, 700 mV within 2%.

Variable Pedestal — ± 5% variation provided for half line insertion in order to exactly match pedestal level of incoming signal.

Noise Levels — −20 dB to −59 dB in 1 dB steps (0 dB = 700 mV RMS).

Flat Noise Spectrum — Energy unit bandwidth, 15 kHz to 5 MHz ±6 dB. (Spectrum extends well beyond 5 MHz.)

Output Impedance — 75 Ω.

Return Loss — ≥30 dB.

INSERTION TEST SIGNALS LINE 17, LINE 330, AND LINE 331 (per CCIR recommendation 569, 473-2, Annex I)

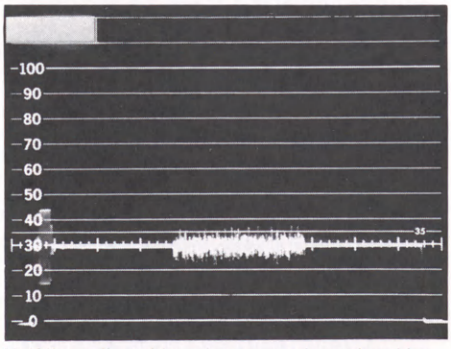
The signals used as vertical interval test signals on Line 17, 330, and 331 are also available full field. The elements of these signals are specified as follows:

LUMINANCE BAR

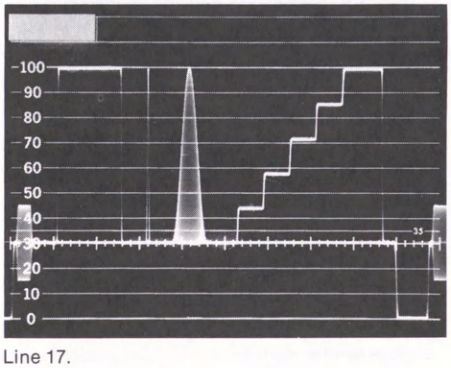
Amplitude — 0.7 V ±1%.

Shape and Time of Rise and Fall — ≈100 ns. May be derived from the shaping network of the sin² pulse or of the staircase waveform.

Tilt — < −0.5% for 10 μs.



Half line adjustable noise comparison signal inserted on a full line.



Line 17.

STAIRCASE SIGNAL

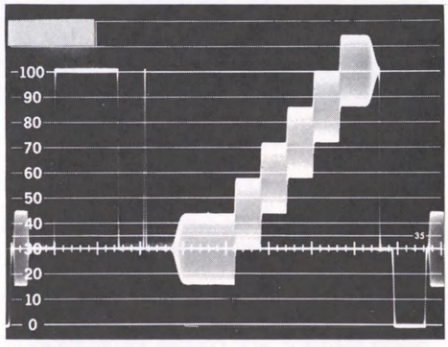
Level of the Uppermost Tread of Staircase — Within ±1% of luminance bar amplitude.

Number of Risers — 5.

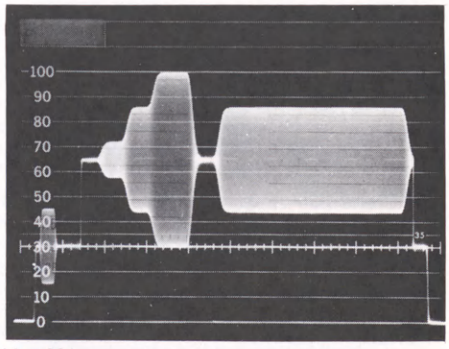
Shape of Risers — Sin² shape with a nominal 200 ns risetime.

Line-Time Nonlinearity — The difference in amplitude between the largest and smallest risers is <0.5% of the largest amplitude.

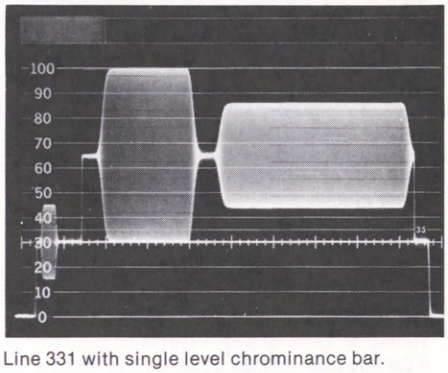
Superimposed Subcarrier Frequency and Phase — 4.43361875 MHz ±10 Hz; 60° ±5° to the B-Y axis referred to the burst (when present).



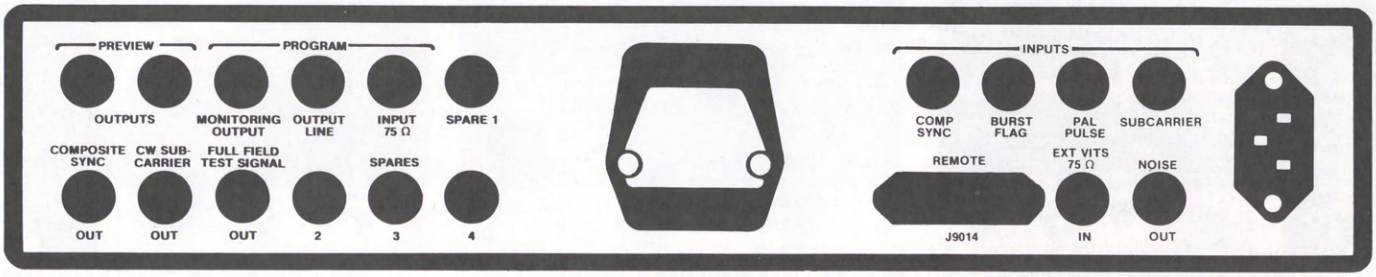
Line 330.



Line 331.



Line 331 with single level chrominance bar.



148/R148 rear panel.

Rise and Fall Times of Subcarrier Superimposed on Staircase — ≈ 1 μs.

Inherent Differential Gain — < 0.5%.

Inherent Differential Phase — < 0.2°.

Amplitude of Superimposed Subcarrier — 0.28 V p-p ± 2% of luminance-bar amplitude.

2T PULSE

Amplitude — ± 1% of luminance bar amplitude.

Half-amplitude Duration — 200 ± 6 ns.

20T COMPOSITE PULSE*

Amplitude — Within ± 1% of luminance bar amplitude.

Half-amplitude Duration — 2 ± 0.06 μs.

Inherent Chrominance/luminance Gain Inequality — < 0.5%.

Inherent Chrominance/luminance Delay Inequality — < 10 ns.

Subcarrier Leak — < 3.5 mV p-p on insertion lines.

Harmonic Content of Subcarrier — < − 40 dB.

Chroma Phase — 60° Standard. Internally adjustable to any phase.

CHROMINANCE BAR

Peak-to-Peak Amplitude — Within ± 1% of luminance bar amplitude.

Pedestal — 0.35 V ± 1%.

Inherent Chrominance/luminance Cross Modulation — 0.5% of pedestal amplitude.

Envelope Rise Time — ≈ 1 μs.

THREE-LEVEL CHROMINANCE BAR**

Position of Transitions — 7H/32, 9H/32, 11H/32, and 14H/32.

*10 T composite pulse available by internal jumper repositioning.

**700 mV chrominance bar, available as an alternative to 3 level bar by simple internal jumper repositioning.

Peak-to-Peak Amplitudes — 1st section, within ± 1% of ⅛ of the luminance bar (nominal value 0.14 V). 2nd section, within ± 1% of ⅜ of the luminance bar (nominal value 0.42 V). 3rd section, within ± 1% of the luminance bar (nominal value 0.7 V).

Pedestal — 0.35 V ± 1%.

Chrominance/luminance Cross Modulation — < 0.5% of pedestal amplitude.

Envelope Rise Time — ≈ 1 μs.

CHROMINANCE REFERENCE

Peak-to-Peak Amplitude — 0.42 V ± 1% of luminance bar amplitude.

Pedestal — 350 mV within 1%.

Envelope Rise Time — ≈ 1 μs.

SOURCE IDENTIFICATION CODE

The Tektronix 148 is a source identification code generator with up to 25 pulses available in any combination on line 16 or 329.

Pulse Width — 1 μs.

One Level — 630 to 700 mV above blanking.

Zero Level — Within 25 mV of blanking.

OTHER CHARACTERISTICS

Power Requirements — 90 to 136 Vac or 180 to 272 Vac; 48 Hz to 66 Hz, 55 W max at 115 Vac and 60 Hz. Factory set at 230 Vac.

Inputs — External ITS, Program, Auxiliary, Composite Sync, Subcarrier, Pal Pulse, and Burst Flag.

Outputs — Program, Program Monitor, Preview Monitor (two each), Full Field, Composite Sync, Subcarrier, and Noise.

Ambient Temperature — Performance characteristics are valid over an ambient temperature range of 0° to + 50 °C.

DIMENSIONS AND WEIGHTS

(Rackmount and cabinet versions have the same dimensions and weights.)

	148		R148	
	in	cm	in	cm
Height	3.875	9.9	3.5	8.9
Width	17.875	43.43	19.0	48.0
Length	17.125	43.43	19.625	49.9
	lb	kg	lb	kg
Net Weight	≈ 19.0	≈ 8.6	≈ 20.0	≈ 9.1
Shipping Weight	≈ 35.0	≈ 15.9	≈ 36.0	≈ 16.3

ORDERING INFORMATION

When ordering please use the exact nomenclature given here.

148 Test Signal Generator

R148 Test Signal Generator (Rackmount)

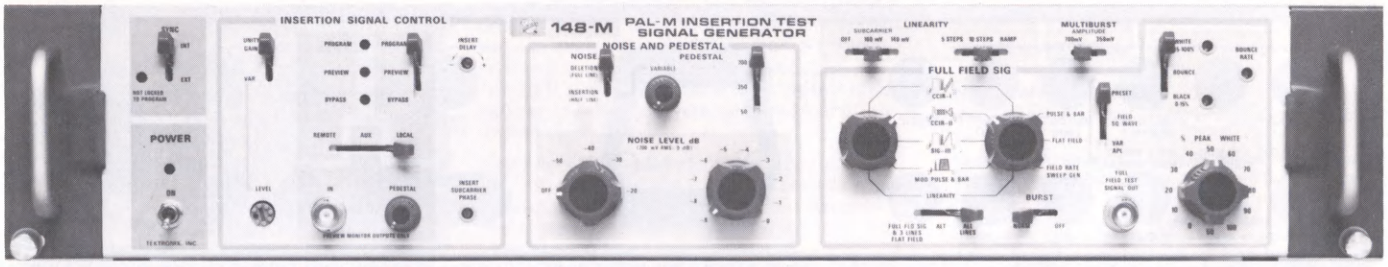
INCLUDED ACCESSORIES

7½ ft. power cable, three wire (161-0036-00); 75 Ω, Bnc termination (011-0103-02); and 2 each BNC-T adapters (103-0030-00). R148 includes rackmounting hardware (351-0195-00).

NOISE MEASUREMENT FILTERS

External filters are required with the 148 Generator when making noise measurements. For systems using 625/50 standards **order**
015-0213-00 Low Pass 5.0 MHz 625/50.
015-0215-00 Noise Weighting 5.0 MHz 625/50.
015-0220-00 Low Pass 6.0 MHz 625/50.
015-0283-00 Unified Noise Weighting Network (per CCIR recommendation 568, use only with 5.0 MHz Low Pass Filter 015-0213-00).

148-M INSERTION TEST SIGNAL GENERATOR



Rackmount version; cabinet version has carrying handle less mounting hardware.

Full-field test signals

Easily reprogrammable

Safe in-service ITS insertion

ITS noise measurement

APL bounce signal

Operate with sound-in-syncs

Locks with:
- **Comp video or comp sync**
- **Subcarrier**
- **PAL pulse**
- **Burst flag**

Insertion Test Signals

The Tektronix 148-M PAL-M Insertion Test Signal (ITS) Generator supplies all the test signals necessary to test and measure video transmission systems. Signals are available as full-field composite video test signals, or as ITS inserted into the vertical blanking interval of an incoming program signal.

All time locations of test signals within the line and field are derived digitally from a master oscilllator locked to the incoming synchronizing signal. Used with a Tektronix 145-M, the 148-M provides standard test signals with gen-locked operation.

Several different test signals may be inserted on successive lines during the vertical blanking interval, providing for a simultaneous check of the complete television transmission system.

With a Preview mode of operation, you can monitor the program signal with insertion signals before adding the ITS to the program signal.

If power fails or if the remote bypass switch is actuated, a relay switch will route the program signal around the instrument, bypassing all circuitry and providing fail-safe operation.

INSERTION CONTROL SYSTEM

Signal Input Level — Unity gain: ±0.5% of unity gain. Variable: 1 V p-p variable within 30%.

Program Input — 75 Ω nominal.

Program Input Return Loss — Power on: ≥46 dB to 5 MHz; power off or bypass: ≥40 dB to 5 MHz.

Outputs — 75 Ω Nominal Impedance. Return loss (all): ≥36 dB to 5 MHz. Blanking dc level: 0 V within 50 mV. Isolation: ≥46 dB to 1 MHz, or 34 dB to 3.58 MHz.

Inserted Signal — Amplitude: within 1% of nominal input. Amplitude Ratio: 2T Pulse to Bar 100% ±0.5%. Mod Sin² Pulsed 100% ±0.5%. Waveform Tilt: line tilt ≤0.25%. Field rates square wave ≤0.5%.

Differential Phase (10-90 APL, Standard Input) —
Program output ≤0.15°.
Preview output ≤0.3°.

Differential Gain (10-90 APL Standard Input) —
Program output ≤0.2%.
Preview output ≤0.4%

Luminance amplitude nonlinearity ≤0.25%.
Random noise output on program output: ≥75 dB (RMS) down.
Residual subcarrier on noninserted lines: ≥60 dB down.
Hum or transients on noninserted lines: ≥60 dB down.
Spurious signals during blanking, ≥40 dB down.
Active picture VITS, ≥60 dB down.

Signal Attenuation in Delete Mode — 2T Pulse: ≥70 dB. Subcarrier (Staircase): ≥60 dB.

Crosstalk into Program Channel from Internal Signal — 2T Pulse: ≥70 dB down. Subcarrier (Staircase): ≥60 dB down.

Insert Delay Range — ≥ ±0.5 μs (1 μs total).

Frequency Response — ±1% to 5 MHz.

Unwanted Pedestal at Time of VITS Insertion — ≤5 mV.

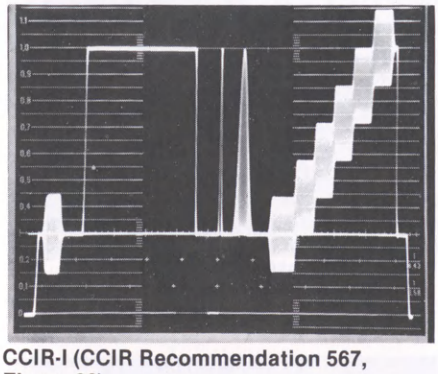
TEST SIGNALS

CCIR-I (recommendation 473-2, Annex I)

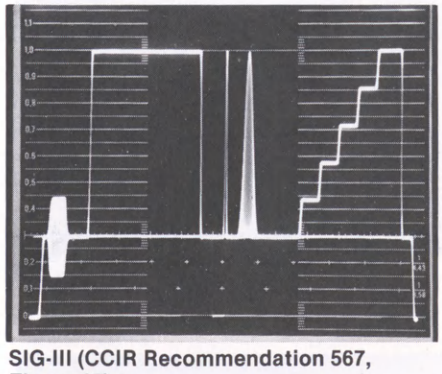
Bar — Amplitude: 700 mV ±1%. Rise time: 230 ns ±15% (2T), 115 ns ±15% (T).

Pulse — Pulse to bar ratio: 100% ±0.5%. HAD: 250 ns ±15% (2T); 125 ns ±15% (T).

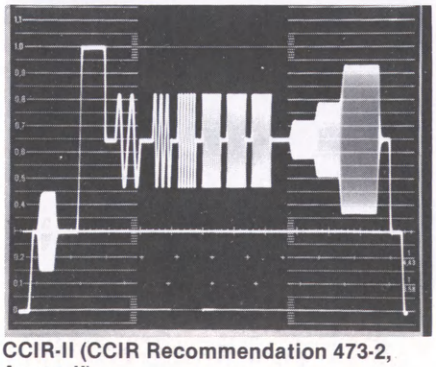
Modulated Sin² Pulse (12.5%) — Amplitude of luminance component: 350 mV ±2%. Amplitude difference of peak chrominance to peak luminance: ≤3.5 mV. Chrominance-luminance delay ≤10 ns.



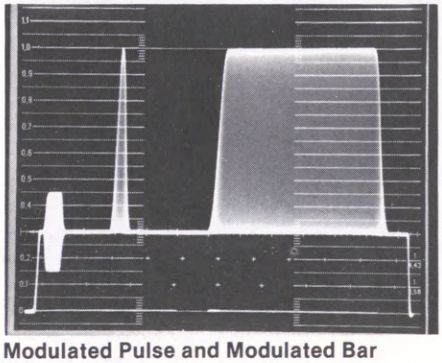
CCIR-I (CCIR Recommendation 567, Figure 28)



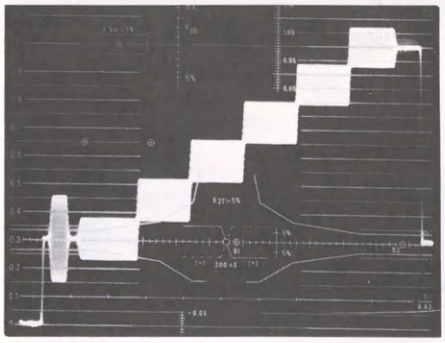
SIG-III (CCIR Recommendation 567, Figure 27)



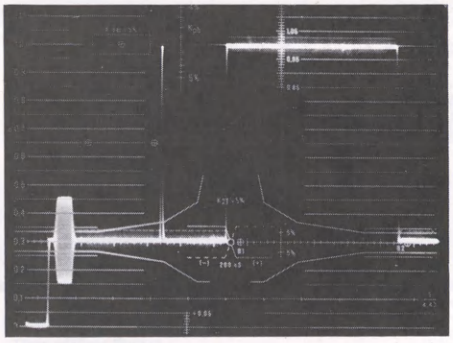
CCIR-II (CCIR Recommendation 473-2, Annex II)



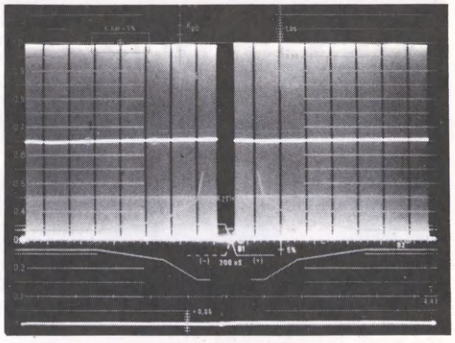
Modulated Pulse and Modulated Bar



Linearity



Pulse and Bar



Field Rate Sweep Generator

Modulated 5 Step Staircase — Luminance step amplitude: 140 mV ±1%. Rise time: 230 ns ±15%. Chrominance amplitude: 280 mV ±1% (Peak-to-Peak). Rise time: 400 ns ±25 ns.

Phase of Chrominance Components — 180° ±5° from U Axis.

CCIR-II (Recommendation 473-2, Annex II)

White Flag Amplitude — 700 mV ±1%.

Burst Amplitude — 700 mV ±1% and 350 mV ±1%.

Average Level — 350 mV ± 5 mV.

Burst Frequencies — 0.5 MHz ±3%, 1.0 MHz ±3%, 2.0 MHz ±3%, 3.0 MHz ±3%, 3.575 MHz ±3%, 4.2 MHz +0% and −2%.

Burst Harmonic Content — ≤40 dB.

Burst Timing — Each burst starts at 0° and consists of a whole number of cycles.

Modulated Pedestal — First chroma level: 140 mV p-p ±1%. Second chroma level: 280 mV p-p ±1%. Third chroma level 560 mV p-p ±1%. Average level: 350 mV ±1%. Phase: 180° ±5° from U Axis. Chrominance rise time 400 ns ±25 ns.

SIG-III (CCIR recommendation 567, Figure 27)

Bar — Amplitude: 700 mV ±1%. Rise time: 230 ns ±15% (2T); 115 ns ±15% (T).

Pulse — Pulse to bar ratio: 100% ±0.5%. Half amplitude duration: 250 ns ±15% (2T); 125 ns ±15% (T).

Modulated Sin² Pulse (12.5T) — Amplitude of luminance component: 350 mV ±2%. Amplitude difference of peak chrominance to peak luminance: ≤3.5 mV. Chrominance to luminance delay: ≤10 ns. Half amplitude duration 1.57 μs ±50 ns. Harmonic content of subcarrier: ≥ −40 dB. Phase (Insertion and Full-Field): 180° ±5° from U axis.

5 Step Luminance Staircase — Step amplitude 140 mV ±15%.

MOD PULSE AND BAR

Modulated Sin² Pulse (12.5T) — Amplitude of luminance component 350 mV ±2%. Amplitude difference of peak chrominance to peak luminance: ≤3.5 mV. Chrominance to luminance delay: ≤10 ns. Half amplitude duration: 1.57 μs ±50 ns.

Modulated Bar — Amplitude of chrominance: 700 mV p-p ±1%. Amplitude of luminance: 350 mV ±2%. Rise time: 1.41 μs ±50 ns. Harmonic content of subcarrier: ≥ −40 dB or greater. Phase (Insertion and Full-Field): 180° ±5° to U Axis.

LINEARITY SIGNAL

Luminance Staircase — Signal step amplitude: 5 Step 140 mV ±1%; 10 Step 70 mV ±1%. Rise time (all identical): 230 ns ±15%.

Chrominance — Off: No chrominance 100 mV: 100 mV ±1% p-p. 140 mV: 140 mV ±1% p-p. Inherent differential gain: ≤0.5%. Inherent differential phase: ≤0.2°. Phase: 180° ±5° from U Axis.

FIELD RATE SWEEP GEN

Swept Frequency Limits — <20 kHz to ≥6 MHz in one field.

Markers — Modulation blanked for 1 line period 7 times per field (or 3 times per field by plug-jumper).

Modulation Amplitude — 700 mV (or 350 mV by multiburst amplitude switch).

Pedestal Amplitude — 350 mV.

PULSE AND BAR

Pulse — Pulse to bar ratio 100% ±0.5%. Half amplitude duration: 250 ns ±15% (2%); 125 ns ±15% (T). Ringing amplitude: ≤0.5%. Ringing duration: ≤2 cycles.

Bar — Amplitude: 700 mV ±1%. Rise Time: 230 ns ±15%. Duration: 26 μs/line x 152 lines.

FLAT FIELD SIGNAL

White — 85% to 100% of peak white.

Black — 0% to 15% of peak white.

Bounce — Automatic bounce between white and black.

Rate — <1 s to >10 s.

Variable APL — 11 levels, each within 0.5% of nominal levels.

Field Square wave — Amplitude 700 mV ±1%. Lines at white: 74 through 206 and 337 through 469. Lines at blanking: all others.

Rise Time — 230 ns ±15%.

NOISE

Pedestal Amplitude — 50 mV: 50 mV ±5 mV. 350 mV: 350 mV ±7 mV. 700 mV: 700 mV ±14 mV.

Variable Pedestal Range — ±7 mV from nominal (14 mV total).

Noise Amplitude — −20 dB to −59 dB (0 dB = 700 mV).

Noise Attenuator Accuracy — Within 1 dB.

Noise Spectrum Bandwidth — 15 kHz to 5 MHz, flat within 6 dB.

FULL-FIELD TEST SIGNAL OUTPUTS

Relative Amplitudes — Within 1% at both outputs.

Return Loss — ≥36 dB to 5 MHz.

Sync Amplitude — 300 mV ±1%.

Burst Amplitude — 300 mV p-p ±3%.

Chrominance Frequency — Free run: 3.57561149 MHz ±25 Hz. Locked mode: locked to incoming burst or external subcarrier.

COMPOSITE SYNC OUTPUT

Amplitude — 4 V negative going ±10%.

Return Loss — ≥ −30 dB to 3.6 MHz.

Rise And Fall Times — 115 ns ±10%.

CW SUBCARRIER OUTPUT

Disabled with loss of incoming sync or burst in INT, or with loss of any input in EXT.

Amplitude — 2 V p-p ±20% in to 75 Ω.

Return Loss — ≥ −30 dB to 5 MHz.

Frequency — Locked to incoming burst of external subcarrier.

INPUTS

Return Loss — ≥ −30 dB to 5 MHz.

Composite Sync — 2 V nominal. Burst Flag — 2 V nominal. Pal Pulse — 2 V nominal. Subcarrier: 2 V nominal.

Ext VITS In — 1 V nominal.

GEN-LOCK

Input requirements — Sync source: nominal 1 V composite video. Sync amplitude: 300 mV, within 6 dB. Burst amplitude: 300 mV, within 12 dB. Burst/sync ratio within 6 dB.

Insert Subcarrier Phase — Range: ±10° nominal via front-panel adjustment.

Subcarrier Lock — Lock-up amplitude. 150 mV p-p of burst information to lock. Drop-out amplitude: ≤50 mV of burst information will allow unlock.

Loss Of Subcarrier Lock — Internal Subcarrier free runs at 3.57561149 MHz ±25 Hz. Subcarrier is not phase locked to sync if external sync is present.

Loss Of Sync — Indicated by front-panel lamp. Instrument returns instantly to internal subcarrier.

Insert Delay Range — ±0.5 μs (1 μs total).

POWER SUPPLY

Line Voltages Selectable — 115 Vac: low, 90 V to 110 V; medium, 104 V to 126 V; high, 112 V to 136 V. 230 Vac: low, 180 V to 220 V; medium, 208 V to 252 V; high, 224 V to 272 V.

Crest Factor — ≥1.35. Line Frequency Range — 48 to 66 Hz. Shipped set at 115 V.

DIMENSIONS AND WEIGHTS

	148		R148	
	in	cm	in	cm
Height	3.875	9.9	3.5	8.9
Width	17.875	45.5	19.0	48.0
Length	17.125	43.6	19.625	49.9
	lb	kg	lb	kg
Net	19.0	8.6	20.0	9.1
Domestic Shipping	35.0	15.9	36.0	16.3
Export-packed	55.0	25.0	56.0	25.4

ORDERING INFORMATION

When ordering please use the exact nomenclature given here.

148-M Test Signal Generator.

R148-M Test Signal Generator (Rackmount).

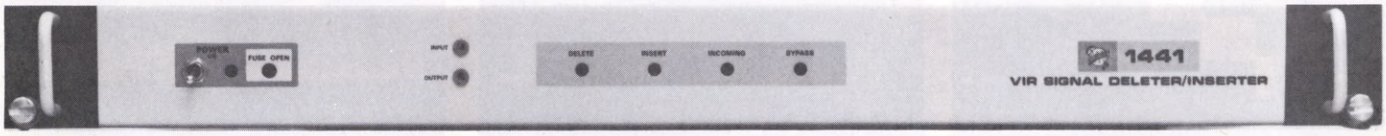
INCLUDED ACCESSORIES

7½ ft power cable, three wire (161-0036-00); 75 Ω, BNC termination (011-0103-02); and 2 each BNC-T adapters (103-0030-00). R148 includes rackmounting hardware (351-0195-00).

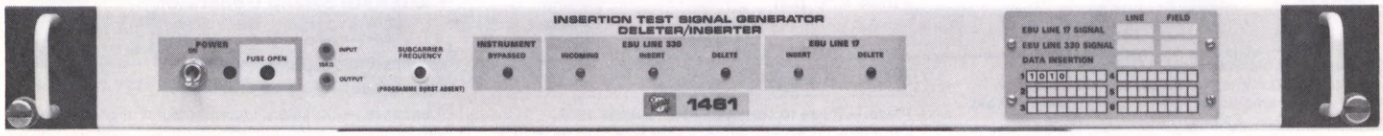
NOISE MEASUREMENT FILTERS

External filters are required with the 148-M Generator when making noise measurements per CCIR recommendation 568. **Order: 015-0213-00 Low-Pass Filter, 5.0 MHz. Order: 015-0283-00, Unified Noise Weighting Filter.**

1441/1461 DELETER/INSERTERS



1441 VIR Signal Deleter/Inserter for 525/60 NTSC Systems.



1461 Insertion Test Signal Generator Deleter/Inserter for 625/50 Systems.

Remote Control

Program Protection

Function Indicators

The Tektronix 1441 (525/60 NTSC Systems)
The 1441 VIR Signal Deleter/Inserter provides an economical means for insertion of the Vertical Interval Reference Signal (VIRS) on line 19 of the video signal. It lets you remotely control the deletion and insertion of the Vertical Interval Reference Signal (VIRS) on line 19 of the video signal. The VIRS is internally generated by the 1441 and remote control is provided from ground closures through a 24 pin connector shipped with the unit.

Selectable functions include:

Passive — Line programmed for VIRS passes without disturbance.

Insert — Deletion of a selected line and insertion of internally generated VIRS always occurs.

Auto — Insert only if VIRS is not present.

Delete — Delete anything on line programmed for VIRS. no insertion occurs.

Front-panel lamps on the 1441 indicate the following conditions:

Presence of a VIRS on the incoming composite video.
Deletion of any signal on the line programmed for VIRS. Insertion of internally generated VIRS in the line programmed for VIRS.
Incoming composite video bypasses to output without disturbance.

The Tektronix 1461 (625/50 Systems)
The 1461 Insertion Test Signal Generator Deleter/Inserter operates for 625/50 PAL television. It can insert either or both of two internally generated insertion test signals (ITS): the EBU line 17 insertion test signal (consisting of a 2T bar, 2T pulse, 20T modulated pulse and five-step staircase), and the EBU line 330 insertion test signal (consisting of a 2T bar, 2T pulse, and five-step modulated staircase). The two signals can be individually programmed to any line within the vertical blanking interval.

A 48 bit Source Identification Code is available for the 1461 (Option 01). The code, like the test signals, can be programmed to any line in the vertical blanking interval. This programming is controlled through internal jumpers.

Code bit widths are 1 μs with 200 ns rise and fall times. Code bit amplitude is adjustable from 40% to 100% of peak white. Insertion of the code information into the video signal is controlled through the 1461's rear panel remote connector. This code configuration may be noted on a front panel plate provided as part of the option.

PROGRAM PROTECTION FOR THE TEKTRONIX 1441 AND 1461

A relay switch in the 1441's and 1461's interface will reroute the program signal in the event of power failure, actuation of a remote bypass switch, or the removal of the instrument from its rack. Program line continuity is maintained and signal delay remains unchanged.

REMOTE CONTROL MODES

The following operating modes can be controlled remotely through the 24 pin remote connect.

Instrument Bypassed — Incoming program signal is routed through a relay and delay-matching network in the Interface of the output connector.

Line 330 Signal Control

Passive — Program signal passes unaffected.

Insert — Deletes incoming line 330 signal and inserts internally generated test signal.

Auto — Inserts only if line 330 ITS is not present.

Delete — Deletes incoming ITS.

Line 17 Control

Passive — Program signal passes unaffected.

Enable — Inserts line 17 or follows line 330 depending on internal jumper.

Source Identification Code

Passive — Program Signal passes unaffected.

Insert — Deletes incoming signal and inserts SID signal.

Delete — Delete incoming signal.

FRONT PANEL INDICATORS

Instrument Bypassed

LED: indicates, when power is on, that the incoming video signal is bypassed in the interface to the program output.

EBU Line 330 (per CCIR recommendation 473-2, Annex I)

INCOMING
LED: indicates Line 330 ITS present on incoming video.
INSERT
LED: indicates Line 330 ITS is inserted on selected line.
DELETE
LED: indicates incoming ITS is deleted.

EBU Line 17 (CCIR recommendation 473-2, Annex I)

INSERT
LED: indicates Line 17 ITS is inserted on selected line.
DELETE
LED: indicates incoming ITS is deleted.

1441/1461 DELETER/INSERTERS

CHARACTERISTICS

Apply to both 1441 and 1461 unless otherwise stated.

PROGRAM PATH

Signal Input Level	1 V p-p Nominal.
Program Gain	
1441	Unity within 0.5%.
1461	Unity within 1%.
Input Return Loss	
Power On	
1441	46 dB to 5 MHz.
1461	≥30 dB at 7 MHz.
Power Off or Bypass	
1441	40 dB to 5 MHz.
1461	≥30 dB at 7 MHz.
Input Impedance	75 Ω nominal.
Output Blanking	
Dc Level	0 V ±50 mV.
Amplitude Ratio	
2T Pulse to Bar	100% ±0.25%.
Mod Sin² Pulse	100% ±0.50%. (Chrom. to Lum.).
Waveform Tilt	
Line Tilt	
26 μs Bar (1441)	<0.25%.
25 μs Bar (1461)	<0.50%.
Field Rate Square Wave	<0.50%.
Differential Phase	
(10%-90% APL, Nominal Input)	≤0.15° (≤0.30° at +3 dB for 1461).
Differential Gain	
(10%-90% APL Nominal Input)	≤0.2% (≤0.4% at +3 dB for 1461).
Line Time Nonlinearity	≤0.25%. (Unmodulated staircase.)
Random Noise Output	≥75 dB (RMS) down. (Weighted up to 5 MHz.)
Non Inserted Lines	
Residual Subcarrier	≥60 dB down. (1441: 3.58 MHz bandpass. 1461: 4.43 MHz bandpass.)
Hum or Transients	≥60 dB down (up to 5 MHz).
Spurious Signals	
1461	
During Blanking	≥40 dB down (up to 5 MHz).
During ITS and Active Picture Lines	≥60 dB down (up to 5 MHz).
1441 Noninserted Lines	≥40 dB down (up to 5 MHz).
Signal Attenuation In Delete Mode	
2T Pulse	≥70 dB.
Subcarrier (Color Bars)	≥60 dB.
Crosstalk Internal Signal To Program Channel	
2T Pulse	≥70 dB down.
Subcarrier	≥60 dB down.
Time Jitter	≤5 ns.
Video Delay	
1441	48° within 5° at subcarrier frequency.
1461	60° ±5° at color subcarrier frequency.
Frequency Response 1461	±1% to 6 MHz, +1% to −6.5%, 6 MHz to 10 MHz.
Unwanted Pedestal At Time of Test Signal Insertion	
1441	≤0.7 IRE.
1461	≤5 mV.
Subcarrier Lock (1461)	
Pull in	≥150 mV p-p Burst.
Hold in	≥50 mV p-p Burst.

1441 VERTICAL INTERVAL REFERENCE SIGNAL

VIR Signal	
Chrominance	
Amplitude	40 IRE within 0.4 IRE.
Phase	180° within 0.5°.
Envelope Rise Time	1 μs.
Phase Change with Burst Amplitude Change	≤1° (Burst amplitude varied from 40 IRE to 20 IRE or to 80 IRE).
Phase Change with Burst Frequency Change	≤1° (Burst frequency changed +10 Hz or −10 Hz from 3.579545 MHz).
Luminance	
Setup Level	7.5 IRE within 0.5 IRE.
Gray Level	50 IRE within 0.5 IRE.
Chroma Pedestal	70 IRE within 0.5 IRE.

1461 INSERTION TEST SIGNALS

Inserted Signal Amplitude	±1% or nominal, 700 mV.
Inserted Signal Blanking Adjustment Range	≥±0.5 μs.
Linearity Staircase Signal	
Luminance	
Amplitude	Within ±1% of luminance-bar amplitude.
Line time nonlinearity	The difference in amplitude between the largest and smallest risers is <0.5% of the largest amplitude.
Rise Time	200 ns ±15% (2T filter)
Number of Risers	5.
Chrominance	
Frequency	
Burst Absent	4.43361875 ±10 Hz.
Burst Present	Frequency locked to burst.
Amplitude	280 mV ±1%.

Inherent Differential Phase	≤0.2%.
Inherent Differential Gain	≤0.5%.
Envelope	
Rise and Fall Time	≈1.0 μs.
Phase	60° ±0.5°.
2T Pulse	±1% of luminance bar amplitude.
Pulse to Bar Ratio	±1% of luminance bar amplitude.
HAD	200 ns ±10 ns.
Ringing	
Amplitude	≤0.5% of pulse amplitude.
Duration	≤4 cycles.
2T Bar	
Rise Time	≈200 ns (2T filter).
Amplitude	700 mV ±1%.
Tilt	<0.5% of bar amplitude, 10 μs period.
Mod Sin² Pulse (20T)	
Amplitude	Within ±1% of luminance bar amplitude.
Chrominance/Luminance Gain Inequality	≤0.5%.
Chroma-Luminance Delay	<10 ns.
HAD	2.0 μs ±0.06 μs.
Residual Subcarrier on Insert Line	<3.5 mV.
Harmonic Content of Subcarrier	40 dB down.
Phase	60° ±5°.

POWER SUPPLY

Line Voltage	
1441	90-132 V ac, 180-264 V ac.
1461	90-136 V ac, 180-272 V ac.
1441 factory set at 115 Vac.	
1461 factory set at 230 Vac.	
Crest Factor	≥1.35.
Max Line Current	
1441	0.25 Amp.
1461	0.3 Amp.
Max Power Consumption	
1441	20 W.
1461	40 W.
Line Frequency	
1441	54-66 Hz.
1461	48-66 Hz.

DIMENSIONS AND WEIGHTS

	in.	cm
Length	16.89	43.10
Height	1.72	4.37
Width	19.00	48.30

ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

1441 VIR Signal Deleter/Inserter, NTSC 525/60

1461 Insertion Test Signal Generator Deleter/Inserter, 625/50

1461 Option 01 Source Identification Code

1430 RANDOM NOISE MEASUREMENT SET

Conforms to CCIR Recommendation 568

In-service testing

Out-of-service testing

Program material protected by fail-safe provisions

525/60 or 625/50 Standards

The 1430 provides random noise measurement capabilities on an in-service basis using the spatially adjacent noise matching technique with a waveform monitor. A program channel allows deletion of VITS and/or noise on selected lines in the vertical blanking interval, and a monitor channel is provided for making measurements in conjunction with a waveform monitor.

The 1430 has two sections. One section, permanently mounted in the rack, contains inputs and outputs and program protecting material. The second section, containing circuitry and controls, may be easily removed without cable disconnection.

PROGRAM CHANNEL

The Program Channel has a 75 Ω input impedance and unity gain and output impedance of 75 Ω. No program impairment is introduced. A relay provides program signal continuity if the 1430 loses power. Internal programming, readily changeable, controls all deletion parameters. Up to three lines between 10 and 21 in either or both fields may be deleted. The deletion may be varied between the first half, second half, or full active portion of the video line. A pedestal may be inserted in the deleted portion of a line at 10, 50, or 100 IRE levels.

MONITOR CHANNEL

The monitor channel has an output independent from program for waveform comparison of the noise on the incoming signal and noise from the internal noise generator. Front-panel controls determine monitor channel parameters with three operating modes: VITS, Full Field, and Out-of-Service.

In the VITS mode, any line between 10 and 21 in either or both fields may be selected for insertion of the reference noise. The Full Field mode provides insertion on all active lines.

The Out-of-Service mode is provided for measurements on sources that do not have composite sync. In particular, these include transmission circuits not carrying signals at the time testing is conducted. Horizontal sync is added for waveform monitor synchronization.

In all modes the insertion width is internally set at 26 μs. Delay between insertion and sync is controlled by the Delay adjustment. A switch and a potentiometer covering a range of 0 - 100 IRE controls the insertion pedestal level.

Monitor channel gain control, with a ±3 dB range, allows nomalizing the signal for 1 V p-p signal so that noise measurement relative to 1 V may be made. The internal noise weighting filter may be switched in or out from the front panel for evaluation of the spectral content of the incoming noise. This filter is in the monitor channel only and does not affect the program output.

The 1430 may be used on both 625/50 and 525/60 systems but is shipped equipped for 525/60. The 1430 Option 01 is equipped for 625/50. Both models use the unified weighting filter per CCIR Recommendation 568. Insertion loss characteristics in the table are approximate.

FREQUENCY (MHz)	1	2	3	4	5
INSERTION LOSS (dB)	5.9	10.2	12.0	13.0	13.6

PROGRAM CHANNEL CHARACTERISTICS

Signal Input Level — 1 V nominal.

Input Impedance — 75 Ω nominal.

Input Return Loss — POWER ON: ≥46 dB to 5 MHz. POWER OFF or BYPASS: ≥40 dB or 5 MHz.

Output Impedance (operating) — 75 Ω nominal.

Output Return Loss (all) — ≥ 30 dB to 5 MHz.

Output Blanking, Dc Level — 0 V within 50 mV, for blanking pulses.

Inserted Pedestal Level — Adjustable to 100, 50, 10, or 0 IRE.

2T Pulse to Bar Amplitude — Within 0.25%.

Mod Sin² Pulse (chrominance and luminance) — 100% within 0.5%.

Waveform Tilt, Field Rate Square wave — ≤0.5%, 26 μs Bar, ≤0.5%.

Differential Phase (10% · 90% APL, standard input) — Program output, ≤0.15°.

Differential Gain (10% · 90% APL, standard input) — Program output: ≤0.2%.

Line Time Amplitude Nonlinearity (10% · 90% APL, standard input) — ≤0.5%.

Random Noise — Program output: ≥75 dB (RMS) down (using weighting and low pass filters, 5 MHz).

Hum or Transients on Noninserted Lines — ≥60 dB down, (using weighted and low pass filters, 5 MHz).

Spurious Signals During Blanking Lines — ≥40 dB down, low pass (5 MHz).

Signal Attenuation in Delete Mode — 2T pulse, ≥70 dB down, Subcarrier (color bars): ≥60 dB down. Insertion pedestal 10, 50, and 100 IRE, first half, second half, or entire line (up to 3; 10 to 21) or full field.

Unwanted Pedestal at Time of VITS Insertion — ≤0.7 IRE.

Time Jitter — ≤5 ns.

NOISE

Noise Measurement Signals — Pedestal Amplitude: 10 IRE, 50 IRE, and 100 IRE.

Pedestal Level — (Insertion mode only) Delay: 10 to 50 μs.

Noise Amplitude — −20 dB to −59.5 dB (0 dB = 700 mV RMS).

Noise Attenuators — Absolute amplitude: within 1 dB.

Noise Spectrum — Energy/unit bandwidth: flat within 6 dB, 15 kHz to 5 MHz.

Output Impedance — 75 Ω nominal.

Output Return Loss — ≥30 dB.

Noise Weighting and Low Pass Filter — Per CCIR recommendation 421-2.

OTHER CHARACTERISTICS

Line Voltage Range — 115 V ac: 90 V to 132 V. 230 V ac: 180 V to 264 V. Standard 1430 factory set at 115 V ac. 1430 Option 01 factory set at 230 V ac.

Max Line Current — 0.25 A.

Max Power Consumption — 30 W.

Line Frequency Range — 48 to 66 Hz.

INCLUDED ACCESSORIES

Three wire power cable (161-0066-00); 1 pr slide guide (351-0331-01); cover program front panel (200-1481-00).

DIMENSIONS AND WEIGHTS

	in	cm
Height	1.72	4.37
Width	19.0	48.26
Length	16.89	42.90
	lb	**kg**
Net	10.0	4.5
Shipping	16.0	7.2

ORDERING INFORMATION

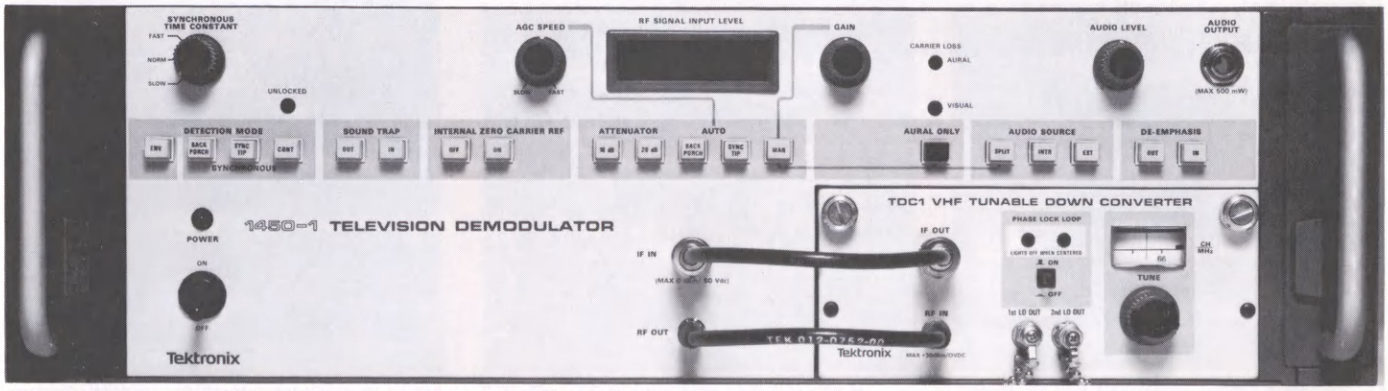
When ordering please use nomenclature given here.

1430 Random Noise Measuring Set (525/60).

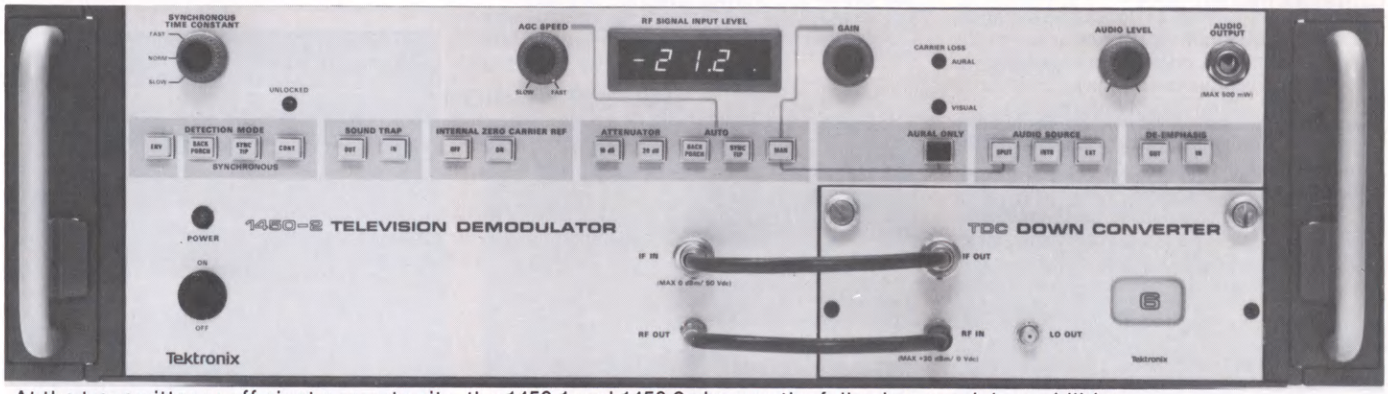
1430 Option 01 Random Noise Measuring Set (625/50).

The 1430 and 1430 Option 01 are provided with the 5.0 MHz low pass filter and unified weighting filter per CCIR Recommendation 568.

1450-1 (SYSTEM M) AND 1450-2 (SYSTEM B/G) TELEVISION DEMODULATORS



The 1450-1 is compatible with System M Television Transmission, and the 1450-2 is compatible with System B/G.



At the transmitter or off-air at a remote site, the 1450-1 and 1450-2 give you the following special capabilities:

Measurement-quality performance resulting in negligible distortion

Synchronous detection that eliminates confusing quadrature distortion

Envelope detection for accurately determining differential phase

Surface acoustic wave filter that provides precise Nyquist slope and excellent long — and short-term stability

Digital readout of input power level for easy, accurate field strength readings

Constant-bandpass characteristics over a wide dynamic range (– 69 dBm to – 3 dBm); 30 dB of additional attenuation available to shift input range

Any single VHF or UHF channel operation

UHF and VHF tunabie down converters (System M only)

Conforms to Electronic Industries Association (EIA) Standard RS-462 (1450-1 only)

The 1450-1 (System M) and 1450-2 (System B/G) Demodulator Mainframes combine with Tektronix Television Down Converters to provide an accurate link between your transmitter's RF signals and video baseband measuring equipment. Unique components work together to identify and eliminate any possible demodulation distortion in reproduced signal characteristics. You see a transparent picture of your transmitter's performance and signal output.

TUNABLE OR FIXED-CHANNEL DOWN CONVERTERS

For demodulating an RF signal at a TV channel frequency, the 1450-1 (M) and 1450-2 (B/G) Demodulator Mainframes must be used with a Tektronix Television Down Converter (TDC). Three compatible TDCs are available for each system and provide a selection between tunable and fixed-channel performance. The TDC Fixed-Channel Down Converter supports your specified system channel number. Tunable Down Converters available for System M VHF and UHF channels are the TDC1 and TDC2 respectively.

Demodulation of the transmitter IF signal may be accomplished by using only the mainframe.

SYNCHRONOUS DETECTION AND ENVELOPE DETECTION

The 1450-1 and 1450-2 allow you to select either synchronous or envelope detection. Each method has advantages, yet both are required for full measurement capability. For instance, synchronous detection is necessary for measurements that can be seriously affected by quadrature distortion.

Both the 1450-1 and the 1450-2 have two synchronous video detectors operating in phase quadrature. One detects the in-phase signal; the other detects the quadrature component of the video signal. (The quadrature component is a measure of change in visual carrier phase resulting from a change of video level.)

However, if incidental phase modulation is present on the picture carrier, the amount of differential phase measured on a synchronously detected signal will be erroneous. Because of this, an envelope detector is necessary to determine the actual differential phase present. The envelope detector of the 1450-1 and 1450-2 has linear transfer characteristics down to 3% carrier and so provides optimum modulation depth indication.

TEKTRONIX-DEVELOPED SURFACE ACOUSTIC WAVE FILTER

The 1450-1 (System M) and 1450-2 (System B/G) feature a surface acoustic wave (SAW) filter developed by Tektronix. It provides more precise Nyquist slope characteristics without group delay distortion, improves long- and short-term stability, and lowers maintenance costs.

1450-1, 1450-2 TELEVISION DEMODULATORS

In conventional demodulators, the more precisely the bandpass characteristics approach an ideal Nyquist curve, the more complex the filter network required. In the 1450-1 and 1450-2 Mainframes however, the bandpass characteristics are determined by just a single component, the SAW filter. Precision is the result.

Conventional tuned IF circuitry must be meticulously adjusted and is subject to change with mechanical and thermal shock. But the SAW filter is in a sealed unit and accurately provides the critical selectivity characteristics of the demodulator — and requires no adjustments.

CONSTANT-BANDPASS CHARACTERISTICS

The Tektronix 1450-1 and 1450-2 offer constant-bandpass characteristics over the entire dynamic range of input signal level. Amplifiers in the mainframe operate at a constant gain, and pin-diode attenuators are used to adjust the overall gain of the demodulator. This more sophisticated approach to automatic gain control (AGC) is necessary to maintain constant-bandpass characteristics over the entire dynamic range of input power (– 69 dBm to – 3 dBm). 30 dB of attenuation, available in 10 dB steps, can shift the range for higher input power levels.

In addition to automatic AGC, demodulator RF/IF gain control can be set for manual operation.

DIGITAL READING OF INPUT POWER

With the accurate (to 0.1 dB) digital readout of the 1450-1 and 1450-2, you get measurements of input power you can depend on at transmitter sites, remote sites, or, for calibrated field strength measurements.

SPLIT AND INTERCARRIER SOUND

For making measurements or adjustments on aural transmitters, the 1450-1 and 1450-2 feature both split and intercarrier sound channels. The split carrier channel, which will operate without the presence of the visual carrier, may be used when making measurements on the aural transmitter only.

Four audio outputs give added measurement capability: a 600 Ω output, two low-impedance outputs for driving a speaker or headphones, and a calibrated output for making deviation measurements with an ac voltmeter or an oscilloscope.

1450-1

Quadrature distortion occurs when a single sideband signal is demodulated with an envelope detector.

Quadrature distortion most severely affects the chrominance signal, causing a loss of brightness in highly saturated colors, especially those at high luminance levels (figures 3 and 4). Narrow white picture elements against the dark backgrounds are reproduced at reduced brightness.

Note reduced pulse width in figure 2 and reduced pulse amplitude in figure 4 caused by envelope detection.

Synchronous detection of the television RF signal eliminates quadrature distortion, allowing the true performance of the transmitter to be determined.

Note in figures 5 through 8 how synchronous detection eliminates the quadrature distortion errors introduced during envelope detection. True transmitter performance may now be determined.

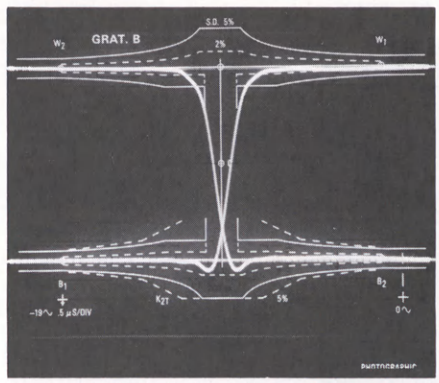


Figure 1. Quadrature distortion causes asymmetrical bar corners, making transmitter equalization difficult.

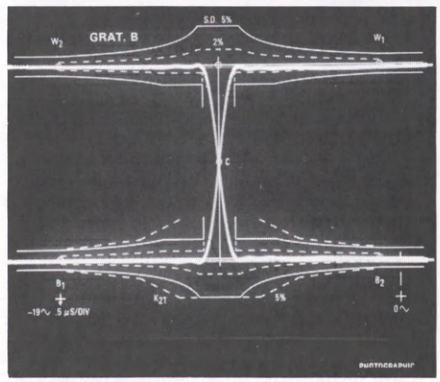


Figure 5.

1450-1 TELEVISION DEMODULATOR MAINFRAME SPECIFICATIONS

System RF Characteristics

	Fixed Channel TDC	Tunable TDC1 or TDC2
RF Input — Z:50 Ω (N).		
Return loss: with 0 dB attenuation	≥ 20 dB	≥ 10 dB
with ≤ 20 dB attenuation	≥ 30 dB	≥ 30 dB
Frequency:	any system M assigned carrier frequency ±20 kHz	(TDC1) All system M VHF assigned carrier frequencies, ± 20 kHz. (TDC2) All system M UHF assigned carrier frequencies, ± 20 kHz.
Level range:*		
(0 dB from mainframe attenuator)	– 69 dBm to – 3 dBm	– 65 dBm to + 1 dBm
(10 dB from mainframe attenuator)	– 59 dBm to + 7 dBm	– 55 dBm to + 11 dBm
(20 dB from mainframe attenuator)	– 49 dBm to + 17 dBm	– 45 dBm to + 21 dBm
(30 dB from mainframe attenuator)	– 39 dBm to + 27 dBm	– 35 dBm to + 31 dBm
AGC range:	66 dB	66 dB
Noise figure:	(VHF) ≤ 10 dB (UHF) ≤ 11 dB	(VHF) TDC1, ≤ 19 dB (UHF) TDC2, ≤ 19 dB
Image rejection ratio:	≥ 60 dB	(1st image) ≥ 50 dB (2nd image) ≥ 60 dB
IF rejection ratio	≥ 60 dB	(1st IF) (VHF) TDC1, ≤ 50 dB (1st IF) (UHF) TDC2, ≤ 30 dB
Adjacent channel cross modulation:	≥ 60 dB	≥ 60 dB
Alternate channel cross modulation:	≥ 60 dB	≥ 60 dB
Variation in system frequency response with AGC:	(VHF) ≤ ± 0.1 dB (UHF) ≤ ± 0.15 dB	≤ 0.3 dB
Readout accuracy:	± 2 dB	± 2 dB
Readout resolution:	± 0.1 dB	± 0.1 dB

*Note: In 50 Ω + 27 dBm = 5 V RMS + 31 dBm = 8 V RMS
– 3 dBm = 158 mV RMS + 1 dBm = 251 mV RMS
– 69 dBm = 80 μV RMS – 65 dBm = 126 μV RMS

1450-1, 1450-2 TELEVISION DEMODULATORS

ENVELOPE DETECTION

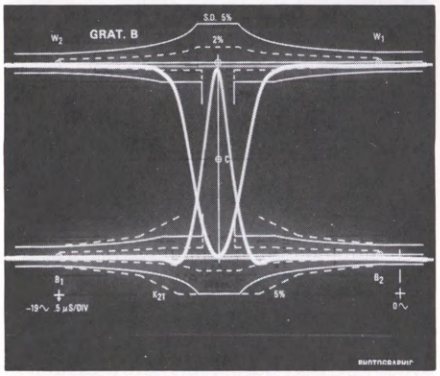


Figure 2. Asymmetry of the normal and inverted 2T sin² pulses caused by quadrature distortion.

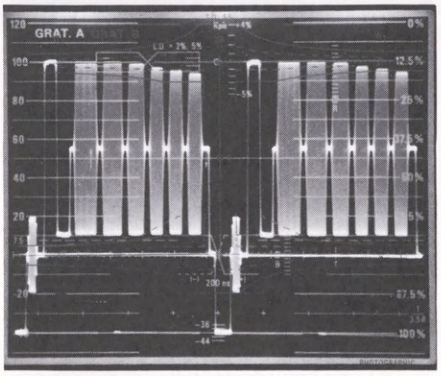


Figure 3. The Tektronix 1450-1's flat IF response and wide band phase-equalized video response minimize the effects of quadrature distortion in the envelope detected signal.

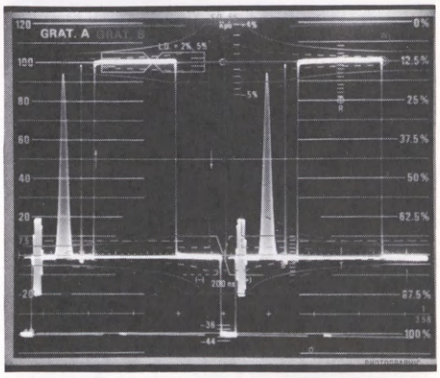


Figure 4. The Tektronix 1450-1's flat IF response and wide band phase-equalization video response minimize the effects of quadrature distortion in the envelope detected signal.

SYNCHRONOUS DETECTION

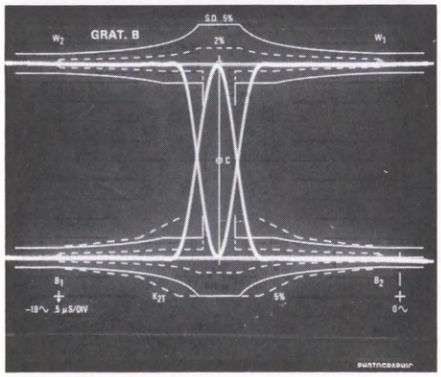


Figure 6.

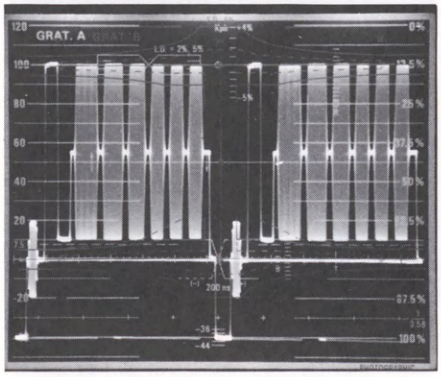


Figure 7.

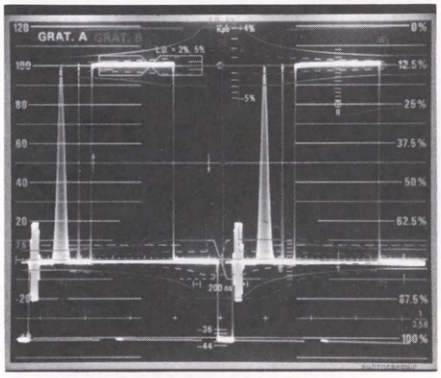


Figure 8.

IF CHARACTERISTICS

IF Input — Z_{in}: 50 Ω (BNC). Return loss: > 18 dB.

IF Level Range — − 20 dBm to − 64 dBm. (Signal to noise ratio deteriorates as signal level decreases.)

IF Frequency — Visual : 37, 38.9, or 45.75 MHz ± 120 kHz (If specified by the mainframe/TDC options). Aural: 4.5 MHz below visual.

VIDEO CHARACTERISTICS

Video Output — Z_o: 75 Ω (BNC, 2 each). Return loss: ≥ 34 dB. Level: 1 V p-p sync tip to peak white.

Dc Level — Back porch AGC: blanking level at 0 V ± 50 mV. Sync tip AGC: referenced to blanking level, sync tip is at − 300 mV ± 6 mV.

Line Time Distortion — 2T k = 0.5% in wideband synchronous mode only. 2T k = 1% in all other modes.

Field Time Distortion — k = 0.5%.

Line Time Nonlinearity — ≤ 1%.

Differential Gain — Synchronous ≤ 1%; Envelope ≤ 4%. Peak chroma level ≤ 100 IRE.

Differential Phase — ≤ 1%.

Zero Carrier Reference Gate — Width: 30 μs ± 10%. Delay — 20 μs ± 10% from leading edge of sync. Carrier cutoff: ≥ 50 dB zero carrier ± 0.5. IRE. Timing: factory set to line 20 of both fields, internally selectable from lines 10 through 25 of both fields.

Chrominance/luminance Delay — ≤ ± 20 ns.

Chrominance/aural/carrier Intermod — ≥ 50 dB down.

Aural Signal Rejection — ≥ 46 dB.

Video Signal to Noise Ratios — Low freq (p-p video/p-p hum): ≥ 60 dB. Mid freq coherent (p-p video/p-p noise): ≥ 50 dB. White Noise (p-p video/RMS noise): ≥ 60 dB (10 kHz to 5 MHz).

Quadrature Output — Z_o: 75 Ω (BNC). Return loss: ≥ 34 dB. Quadrature Phase — 90° ± 2° (with respect to VIDEO OUT).

EXT Zero Carrier Reference Drive Input — Z_{in}: ≈ 5 kΩ (BNC). Level required: ≈ + 1 V (accepts input from Tektronix 1440).

AUDIO CHARACTERISTICS

Frequency Response — De-emphasis out: flat ± 0.4 dB (30 Hz to 15 kHz). De-emphasis in: standard 75 ns de-emphasis curve ± 0.4 dB.

Harmonic Distortion — ≤ 0.2% (50 Hz to 15 kHz at full output with ± 25 kHz deviation).

Audio Signal to Noise Ratio — Intercarrier mode: ≥ 55 dB with ± 25 kHz deviation. Split carrier mode: ≥ 75 dB with ± 25 kHz deviation. External Aural Intercarrier In: ≥ 75 dB with ± 25 kHz deviation. Aural Only Mode: ≥ 75 dB with ± 25 kHz deviation.

Deviation Output — Z_o: 600 Ω (BNC). Level: 50 mV/kHz ± 1%. (20 kHz/V ± 1%).

Aural Intercarrier In — Z_{in}: 50 Ω (BNC). Return loss: ≥ 20 dB. Level: − 30 dBm ± 5 dB. Frequency: 4.5 MHz ± 1 kHz.

Aural Intercarrier Output — Z_o: 50 Ω (BNC). Return loss: ≥ 20 dB. Level: nominal − 6 dBm up to 0 dBm.

600 Ω Balanced Line Output — Level: + 10 dBm (Internally adjustable from ≤ − 10 dBm to + 15 dBm). Connector: XLR.

8 Ω Speaker Output — Level: up to 5 W RMS, front panel adjustable. Connector: barrier block.

Headphone Output — Level: up to 50 mW into 8 Ω headphone (stereo or mono style). Connector: phone jack.

Remote Connector — Alarm output: SPDT relay contact rated at 28 V, 3 A. External synchronous/envelope switch: ground for envelope detection.

Electromagnetic Susceptibility — up to 10 V/meter.

Damage Level at RF Input — 1 W max (any attenuator setting).

Rear Panel Outputs — Video. BNC, 2 each Quadrature. BNC Deviation, BNC 4.5 MHz. BNC 600 Ω (balanced) 8 Ω speaker.

Rear Panel Inputs — 50 Ω RF. N; 4.5 MHz, BNC; External zero carrier, BNC; remote alarm jack.

1450-1, 1450-2 TELEVISION DEMODULATORS

1450-2
Quadrature distortion occurs when a single sideband signal is demodulated with an envelope detector.

Quadrature distortion most severely affects the chrominance signal, causing a loss of brightness in highly saturated colors, especially those at high luminance levels. Narrow white picture elements against the dark backgrounds are reproduced at reduced brightness.

For true monitoring of the transmitter's performance, synchronous detection must be used to eliminate quadrature distortion.

However, envelope detection is still necessary for measuring differential phase, since it accurately determines any incidental phase modulation.

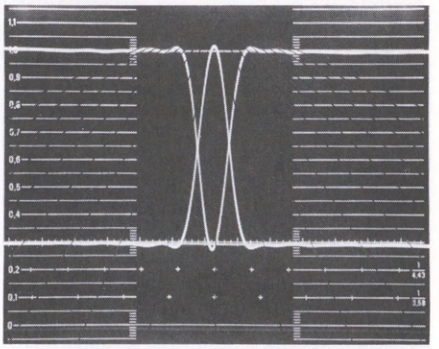


Figure 1. 2T pulses, normal and inverted, synchronously detected, narrow band IF.

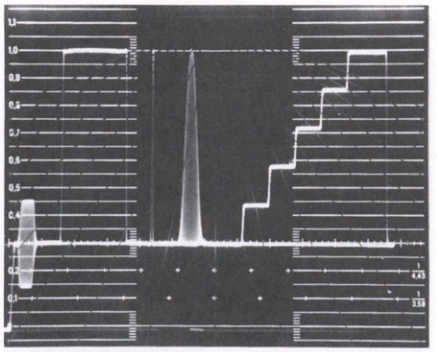


Figure 5. EBU Line 17 ITS, synchronously demodulated.

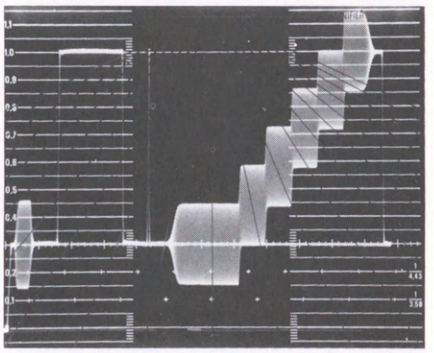


Figure 6. EBU Line 330 ITS, synchronously demodulated.

TELEVISION DEMODULATOR SPECIFICATIONS

System RF Characteristics with Fixed-Channel TDC

RF Input — Z:50 Ω (N)

Return loss — ≥ 20 dB with 0 dB attenuation
≥ 30 dB with 20 dB attenuation

Frequency — System B or System G assigned carrier frequency, ± 20 kHz

Level Range — * – 69 dBm to – 3 dBm (0 dB mainframe attenuation)
– 59 dBm to + 7 dBm (10 dB mainframe attenuation)
– 49 dBm to + 17 dBm (20 dB mainframe attenuation)
– 39 dBm to + 27 dBm (30 dB mainframe attenuation)

AGC Range — 66 dB

Noise Figure — (VHF) ≤ 10 dB; (UHF) ≤ 11 dB

Image Rejection Ratio — (VHF) ≥ 60 dB; (UHF) ≥ 50 dB

IF Rejection Ratio — ≥ 60 dB.

Adjacent Channel Cross Modulation — ≥ 60 dB down.

Alternate Channel Cross Modulation — ≥ 60 dB down.

Variation in System Frequency Response with AGC — (VHF) ≤ ± 0.1 dB; (UHF) ≤ ± 0.15 dB

Readout Accuracy — ± 2 dB.

Readout Resolution — ± 0.1 dB.

*Note: In 50 Ω: + 27 dBm = 5V RMS
– 3 dBm = 158 mV RMS
– 69 dBm = 80 μV RMS

IF CHARACTERISTICS

IF Input — Z_{in}: 50 Ω (BNC). Return loss: > 18 dB.

IF Level Range — – 20 dBm to – 64 dBm. (Signal to noise ratio deteriorates as signal level decreases.)

IF Frequency — Visual: 38.9 MHz ± 100 kHz; Aural: 5.5 MHz below visual.

VIDEO CHARACTERISTICS

Video Outputs — Two Z: 75 Ω (BNC, 2 each). Return loss: ≥ 34 dB level: 1 V p-p sync tip to peak white.

Dc Level — Back porch AGC: blanking level at 0 V ± 50 mV. Sync tip AGC: referenced to blanking level, sync tip is at – 286 mV ± 5.7 mV.

Line Time Distortion — ≤ 0.5%, wideband IF, synchronous detection. 1.0% in all other IF, detection mode combinations.

Field Time Distortion — ≤ 0.5%.

Line Time Nonlinearity — ≥ 0.5%.

Differential Gain — Synchronous ≤ 1%. Envelope ≤ 1%.

Chrominance/luminance Delay — ≤ ± 20 ns.

Chrominance/aural Carrier Intermod — ≥ 50 dB down.

Aural Signal Rejection — ≥ 46 dB.

1450-1, 1450-2 TELEVISION DEMODULATORS

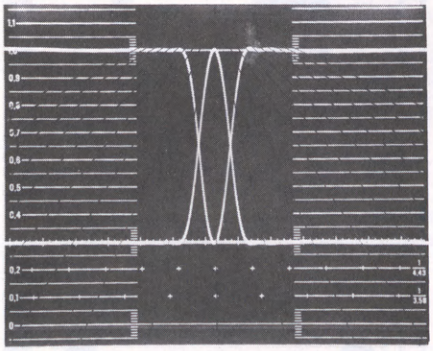


Figure 2. 2T pulses normal and inverted, synchronously detected, wide band IF.

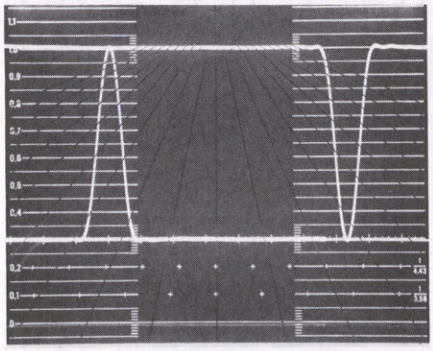


Figure 3. 2T pulse-to-bar ratio display, synchronously detected, wide band IF. Inverted 2T pulse also shown.

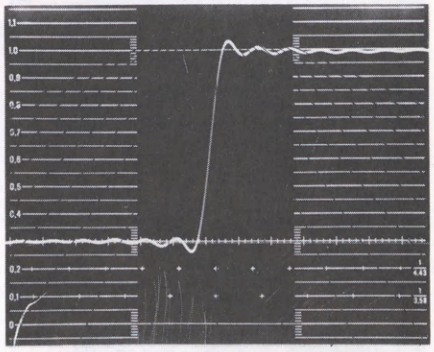


Figure 4. 100 ns T step, synchronously detected, narrow band IF. Note excellent group envelope delay, symmetrical ringing.

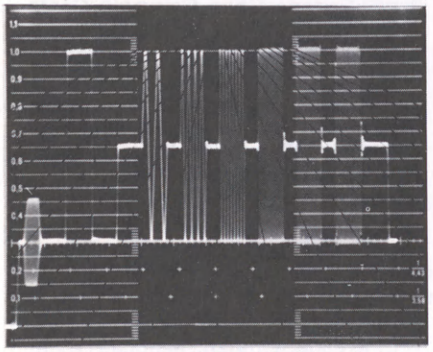


Figure 7. Multiburst 0.5, 1.0, 2.0, 4.0, 4.8 and 5.8 MHz. Synchronously detected, wide band IF.

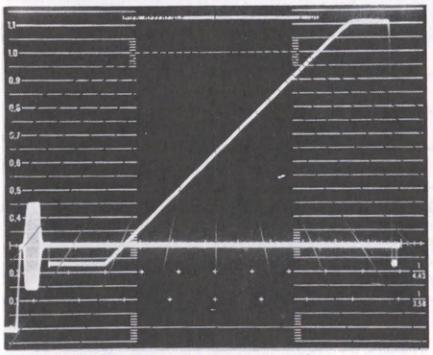


Figure 8. Excellent linearity of envelope detected video. Ramp signal extends linearity to 2% carrier. Zero carrier reference pulse is shown (top center).

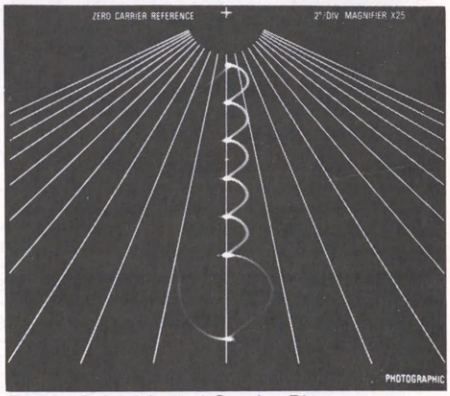


Figure 9. Incidental Carrier Phase Modulation measurement display 2°/radial. 5 step staircase shown.

Video Signal to Noise Ratio — Low freq (p-p video/p-p hum): ≥60 dB. Mid freq coherent (p-p video/p-p noise): ≥50 dB. White noise (p-p video/RMS noise): ≥60 dB (10 kHz to 5 MHz).

Quadrature Output — Z: 75 Ω (BNC). Return loss: ≥34 dB. Quadrature phase: 90° ±2° (with respect to VIDEO OUT).

Zero Carrier Reference Gate — Width: 30 μs ±10%. Carrier cutoff: ≥50 dB, zero carrier ±5 mV. Timing: factory set to Line 16 of both fields, internally selectable from lines 10 through 25 of both fields.

EXT Zero Carrier Reference Drive Input — Z_{in}: ≈5 KΩ (BNC). Level required ≈ +1 V (accepts input from Tektronix 1460).

AUDIO CHARACTERISTICS

Frequency Response — De-emphasis out: Flat ±0.4 dB. (30 Hz to 25 kHz). De-emphasis in: standard 50 μs de-emphasis curve ±0.5 dB.

Harmonic Distortion — ≤0.2% (50 Hz to 15 kHz at full output with ±50 kHz deviation).

Audio Signal to Noise Ratio — Intercarrier mode: ≥55 dB with ±50 kHz deviation and 1 kHz modulation. Split carrier: ≥75 dB with ±50 kHz deviation and 1 kHz modulation. EXT aural intercarrier IN: ≥75 dB with ±50 kHz deviation and 1 kHz modulation. Aural Only — ≥75 dB with ±50 kHz dev and 1 kHz modulation.

Deviation Output — Z_o 600 Ω (BNC). Level: 50 mV/kHz ±1%; 20 kHz/V ±1%.

Aural Intercarrier IN — Z_{in}: 50 Ω (BNC). Return loss: ≥20 dB. Level: −30 dBm ±5 dB. Frequency: 5.5 MHz ±1 kHz.

Aural Intercarrier Output — Z_o: 50 Ω (BNC). Return loss: ≥20 dB. Level: nominal −6 dBm up to 0 dBm.

600 Ω Balanced Line Output — Level: +10 dBm (internally adjustable from at least −10 dBm to +15 dBm). Connector: XLR.

8 Ω Speaker Output — Level: up to 5 W RMS, front panel adjustable. Connector: barrier block.

Headphone Output — Level: up to 50 mW into 8 Ω headphone (Stereo or mono style). Connector: phone jack.

Remote Connector — Alarm output: SPDT relay contact rated at 28 V. 3 A. External synchronous/envelope switch: ground for envelope detection.

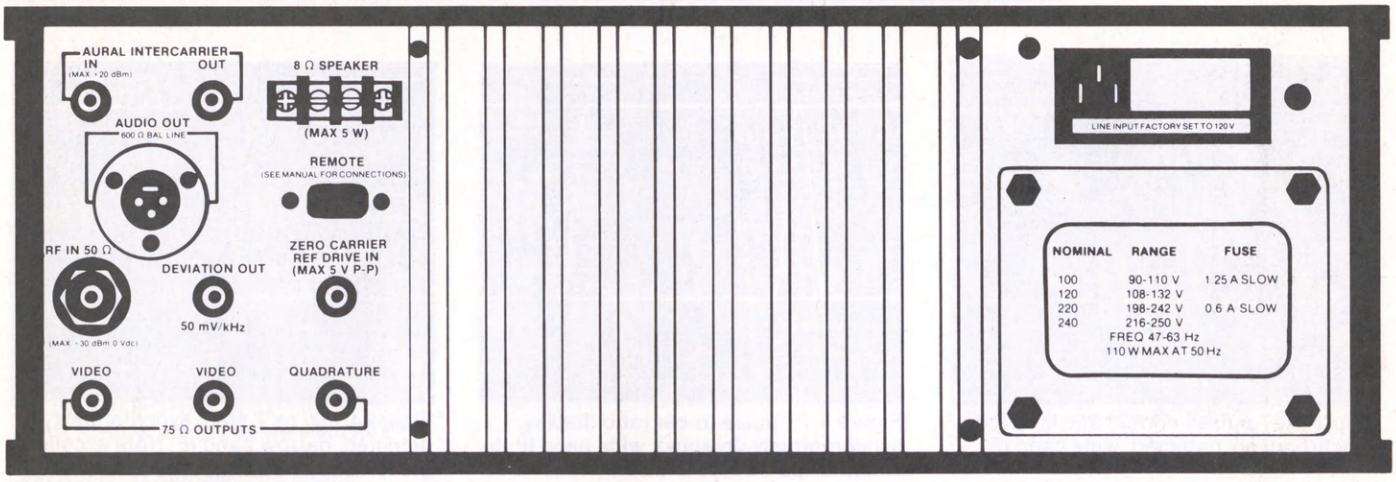
Electromagnetic Susceptibility — up to 10 V/Meter.

Damage Level at RF Input — 1 W max (any attenuator setting).

Rear Panel Outputs — Video, BNC, 2 each Quadrature, BNC, Deviation, BNC, 5.5 MHz, BNC, 600 Ω (balanced), 8 Ω speaker, Remote alarm jack.

Rear Panel Inputs — 50 Ω RF, N; 5.5 MHz, BNC; External zero carrier, BNC; Remote alarm jack.

1450-1, 1450-2 ORDERING INFORMATION



ORDERING INFORMATION, SYSTEM M

When ordering, please use the exact nomenclature given here.

1450-1: (order one vision IF option.)

Option 01: 37 MHz vision IF.

Option 02: 38.9 MHz vision IF.

Option 03: 45.75 MHz vision IF.

TDC Fixed Channel Down Converter (stipulate channel number when ordering).

TDC-1 Tunable Down Converter — System M, VHF Band.

TDC-2 Tunable Down Converter — System M, UHF Band.

Order one vision IF Option and Option 11 or 14.
If your country is not listed, contact your nearest field office for a quotation.

Option 01: 37 MHz vision IF.

Option 02: 38.9 MHz vision IF.

Option 03: 45.75 MHz vision IF.

Option 11: System M countries.

Option 14: System M countries.

ORDERING INFORMATION, SYSTEM B/G

1450-2: (Order one vision IF option and one group delay option).

Option 02: 38.9 MHz vision IF.

Option 09: +90/−170 ns group delay

TDC Fixed Channel Down Converter (stipulate channel number when ordering).

Order one vision IF option and Option 12. If your country is not listed, contact your nearest field office for a quotation.

Option 02: 38.9 MHz vision IF.

Option 12: System B/G countries.

COUNTRIES: SYSTEM M (Option 11)

Antigua, Argentina, Barbados, Bermuda, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Curacao, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Johnston Islands, Korea, Mexico, Micronesia, Netherlands Antilles, Nicaragua, Panama, Peru, Phillipines, Puerto Rico, Samoa, St. Kitts, Surinam, Taiwan, Trinidad/Tobago, Uruguay, U.S.A., Venezuela, Virgin Islands.

COUNTRIES: SYSTEM M (Option 14)

Japan and Okinawa.

COUNTRIES: SYSTEM B/G (Option 12)

Algeria, Austria, Bahrain, Bangladesh, Belgium,* Brunei, Cyprus, Denmark, East Germany, Egypt, Ethiopia, Finland, Ghana, Gibraltar, Greece, Guinea, Hong Kong,* Iceland, India, Indonesia, Iran, Israel, Italy (UHF), Jordan, Kenya, Kuwait, Lebanon, Liberia, Libya, Malta, Mauritius, Netherlands, Nigeria, Norway, Oman, Pakistan, Portugal, Qatar, Rhodesia, Saudi Arabia,* Sierra Leone, Singapore, Spain, Sudan, Sweden, Switzerland, Syria, Tanzania, Tunisia, Turkey, Uganda, United Arab Emirates, West Germany, Yemen Arab Republic, Republic of Yemen, Yugoslavia, Zambia.

*System B only.

TELEVISION SIDEBAND ANALYZER

Response of transmitter under test within ±0.2 dB

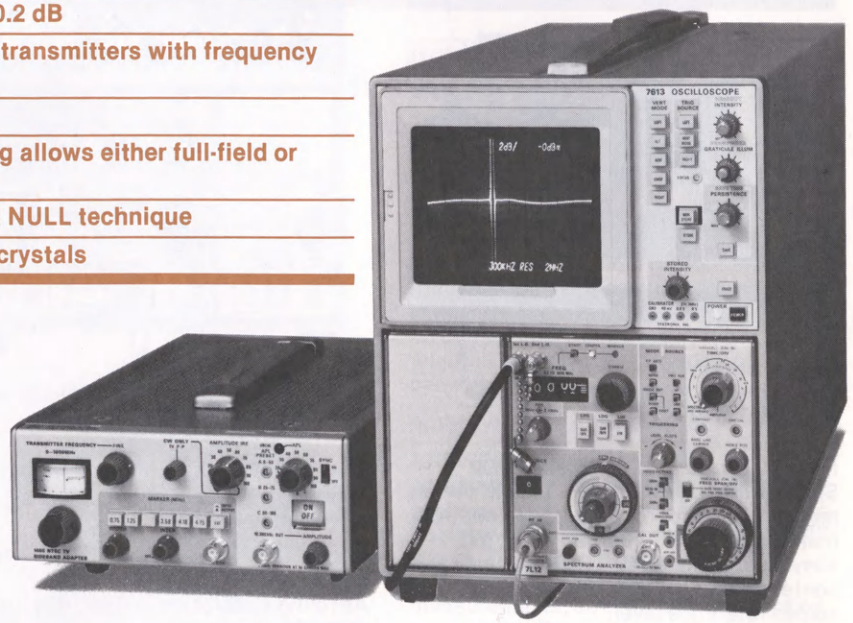
Frequency response of RF and IF circuits for transmitters with frequency to 1 GHz

Video circuits can be swept (0-15 MHz)

For in-service testing, use of external blanking allows either full-field or single-line operation

Check aural FM deviation with built-in Bessel NULL technique

Flexible marker system will accept standard crystals



7L12 Spectrum Analyzer
7613 Variable Persistence Mainframe
1405 Television Sideband Adapter

Use the 1405 with a spectrum analyzer, such as the 7L12 or 7L13, to analyze the sideband response of a television transmitter. The 1405 generates a composite video signal, the "picture" portion of which is a constant-amplitude sinusoidal signal that sweeps 15-0-15 MHz. This signal is applied as modulation to a television transmitter; the output is then displayed on the spectrum analyzer and appears as the response curve of the transmitter under test. The 1405/spectrum analyzer combination will display the frequency response characteristics of RF and IF circuits for transmitters with frequencies to 1 GHz. Video circuits (zero frequency offset) can also be analyzed.

CHARACTERISTICS

The following characteristics apply to the 1405 and 1405/7L12 or 7L13 combination. They are applicable over the environmental specification limits for the 1405 and 7000 Series Mainframes.

FREQUENCY (Frequency Offset)

Range — will tune and provide a swept video output for a 7L12 or 7L13 center frequency range of 0 to 1 GHz.

Frequency Dial Accuracy — dial reading is within 10 MHz of transmitter frequency when properly tuned.

Fine Tuning Range — from ±0.5 MHz to ±1.25 MHz, depending upon transmitter frequency setting.

Tuned Frequency Drift — <1 MHz per hour after a 30 minute warm-up.

OUTPUT SIGNAL LEVEL

Amplitude (Sync Off) — 100 IRE equals 0.714 V p-p when terminated in 75 Ω.

Output Impedance — 75 Ω ±1% at 100 IRE and ±2% from 0 to 90 IRE.

Variable — 0 to 100 IRE in 10 IRE steps.

Accuracy (at 200 kHz) — ±1 IRE at 100 IRE; ±2 IRE from 10 IRE to 90 IRE.

Output Level During Blanking — 0 V ±0.01 V at 0 IRE; 0 V ±0.04 V at 100 IRE from 0 to 1 MHz; 0 V ±0.02 V at 100 IRE above 1 MHz.

Cw Output Harmonics — down 40 dB or more.

FLATNESS

1405 — Within ±0.1 dB from 100 kHz to 10 MHz, within ±0.2 dB from 10 MHz to 15 MHz, within ±0.4 dB from 50 kHz to 20 MHz.

1405 plus 7L12 or 7L13, for transmitter frequency >20 MHz — Within ±0.2 dB from 100 kHz to 10 MHz of picture carrier, increasing to ±0.3 dB at 15 MHz; within ±0.5 dB from 50 kHz to 20 MHz.

For transmitter frequency of 0 to 20 MHz — within ±0.5 dB from 100 kHz to 15 MHz.

System Span — ≥200 kHz per division.

Video Frequency Range — 15-0-15 MHz.

AVERAGE PICTURE LEVEL (APL)

Variable — 0 to 100 IRE in 10 IRE steps.

Accuracy — ±2 IRE.

Three Preset Levels — PRESET A: 0 to 50 IRE. PRESET B: 25 IRE to 75 IRE. PRESET C: 50 IRE TO 100 IRE.

Horizontal Sync, Blanking, and Pedestal Duration — within NTSC (PAL — Opt. 01) limits (no vertical interval is provided). Transition time is 0.24 μs ±10%, from 10% to 90% points.

Composite Sync Source Blanking — 0 V turns cw on > — 5 V turns cw off.

Line Strobe — TTL pulse from 0 to 5 V turns cw on.

AURAL OUTPUT

Output Frequency — 10.396 kHz, ±0.01% (crystal controlled). Opt. 01, 9.058 kHz.

CW Output — Amplitude variable up to ≥ +12 dBm into 600 Ω. Harmonics down 45 dB or more.

Crystal Requirements — Series resonant: $R_1 < 2000\ \Omega$; $Q > 5000$; Case, HC/6U or HC/25U.

MARKER CRYSTAL INSTALLATION

Because of the various international standards the 1405 Option 01 is shipped with the marker crystals installed. Frequencies installed are 0.75, 1.25, 2.25, 4.43, 5.00, and 5.75 MHz. Additional crystals are shipped with the unit.

Note: Option 01 instruments are connected for a nominal power line voltage of 240 V.

ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

1405 TV Sideband Adapter (NTSC markers)

1405 Option 01 TV Sideband Adapter (625/50 markers)

016-0489-00 Rack Adapter

7L12 Spectrum Analyzer

7L13 Spectrum Analyzer

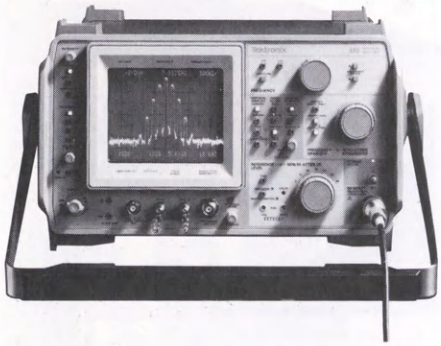
7603 Mainframe

Option 77 P7 Phosphor and Internal S.A. Graticule

Option 06 Internal S.A. Graticule

7613 Variable Persistence Mainframe Option 06 Internal S.A. Graticule

SPECTRUM ANALYZERS



The 492 video to microwave portable spectrum analyzer.

From 50 kHz to over 21 GHz, our 492 Spectrum Analyzer delivers full lab performance. Its microprocessor aided controls make front panel operation quick and easy. Just make three simple settings for center frequency, frequency span and full screen reference level.

100 Hz resolution and optional phaselock permits fine detail spectral purity analysis.

Parameters and front panel settings are displayed on the CRT, so all information is available at a glance. Photographic documentation of the display is simple and complete.

Applications include: TV transmitter harmonic testing, TV transmitter frequency response (with 1405 Sideband Adapter), UHF and microwave STL performance, field strength and site survey measurements, RFI/EMI measurements, satellite earth station performance plus FCC AM, FM and TV transmitter tests.

492 SALIENT CHARACTERISTICS

Frequency range 50 kHz to 21 GHz with internal mixer (to 60 GHz with optional external waveguide mixers)

On screen calibrated dynamic range of 80 dB.

100 Hz resolution for close-in sideband analysis.

– 115 dBm sensitivity for spurious response detection.

Portable form factor for easier movement and compact for operation around racks and equipment.

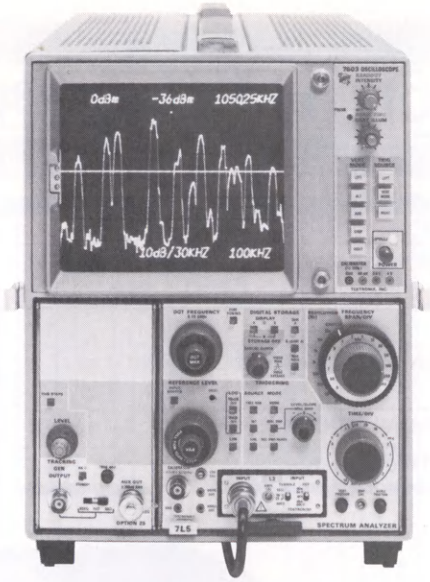
Options to fit your individual needs and budgets.

Fully programmable GPIB option for future needs.

ORDERING INFORMATION

492 Spectrum Analyzer
Option 01, Preselector
Option 02, Digital Storage
Option 03, 100 Hz Res. + Phase Lock
492P GPIB Compatible and Programmable

(all 492 options apply)



7L5 20 Hz to 5 MHz Audio/Baseband spectrum analyzer

Easy to use — three knob operation.

Synthesizer stability for six-digit accuracy of center frequency.

Digital storage and averaging of display signals.

Absolute calibration in dBm, dBv, or volts/div.

Changeable input impedance modules to accommodate any impedance requirement.

The 7L5 has a one knob amplitude control and selected reference level in one or ten dB steps. This makes calibrated amplitude measurements such as harmonic distortion, AM percent of modulation, noise and spurious levels simple.

The 7L5 with option 25 Tracking Generator is ideal for audio frequency response measurements.

Digital storage and CRT readout provide clean easy to interpret displays and a built-in micro computer processes front panel controls for ease of operation.

7L5 OPTION 25 CHARACTERISTICS

Frequency range — 20 Hz to 5 MHz

Frequency span — 50 Hz/div. to 500 kHz/div.

Residual FM — ≤1 Hz (p-p)

Frequency drift — ≤5 Hz/hr.

Resolution bandwidth — selected bandwidths from 10 Hz to 30 kHz.

Sensitivity — – 135 dBm (– 148 dBv) at 30 Hz resolution bandwidth.

On-screen dynamic range — 80 dB

Input impedance — 50 Ω, 75 Ω, 600 Ω, 1 MΩ (depends on input module selected)

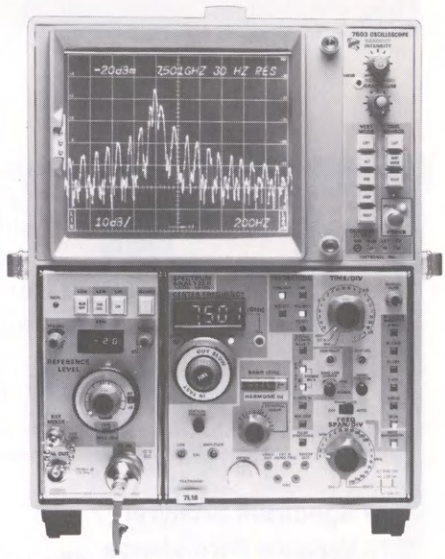
Option 25 frequency range — 20 Hz to 5 MHz

Option 25 output impedance — 50 Ω, 75 Ω, or 600 Ω

Option 25 amplitude range — 50 Ω: 0 dBm to – 63 dBm, 75 Ω: – 6 dBm to – 69 dBm, 600 Ω: – 17 dBm to – 80 dBm.

ORDERING INFORMATION

7L5 Spectrum Analyzer
Option 25 Tracking Generator
L1 Plug-in Module (50 Ω)
L3 Plug-in Module (1 MΩ, 50 Ω, 600 Ω)
L3 Option 01 (1 MΩ, 75 Ω, 600 Ω)
7603 Oscilloscope
R7603 Oscilloscope (rackmount)
Option 06 Internal SA Graticule



7L18 1.5 to 60 GHz Microwave spectrum analyzer

30 Hz resolution to 12 GHz.

Microprocessor-aided front panel controls.

Digital storage and averaging of display signals.

Transportable — 48 pounds (21.8 kilograms) including 7603 Mainframe.

Preselected for freedom from spurious responses.

The 7L18 is the ideal spectrum analyzer for making accurate measurements at microwave frequencies. Harmonic distortion, deviation, field intensity, and signal-to-noise ratio are some of the measurements the 7L18 performs with ease at microwave carrier frequencies.

The built-in preselector and excellent distortion characteristics allow for easy spurious response measurements.

7L18 CHARACTERISTICS

Frequency range — 1.5 to 60.5 GHz

Frequency span — 20 calibrated span widths from 200 Hz/div. to 500 MHz/div.

Tracking preselector — Internal and automatic 1.5 — 18 GHz. Rejection of harmonic mixing, image and multiple responses >70 dB.

Residual FM — Stabilized 10 Hz peak-to-peak x N (mixing mode).

Frequency drift — Stabilized 2 kHz/hr. XN after two hour warm up.

Resolution bandwidth — Selectable bandwidths from 30 Hz to 3 MHz in decade steps.

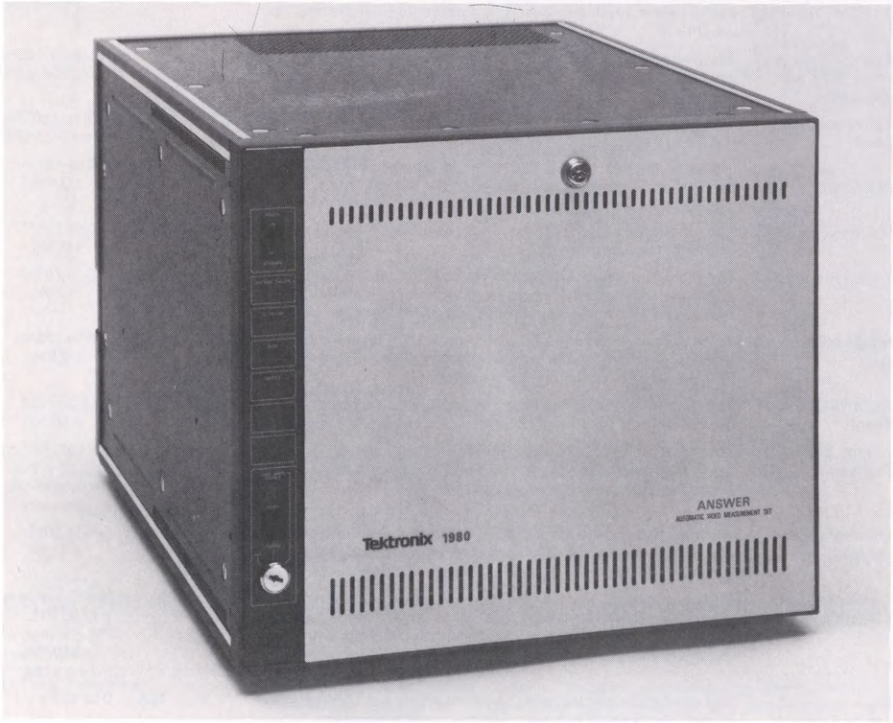
Sensitivity — – 119 dBm at 300 Hz resolution bandwidth (fundamental mixing mode)

On-screen dynamic range — 80 dB

ORDERING INFORMATION

7L18 Spectrum Analyzer
7603 Oscilloscope
R7603 Oscilloscope (rackmount)
Option 06 Internal SA Graticule

1980 ANSWER OPTION 01
AUTOMATIC VIDEO MEASUREMENT SET



All-Digital Circuitry

Automatic Operation

Programmability

The 1980 ANSWER is an automatic measurement set offering total video test capabilities. It's programmed to make both NTC 7 and FCC measurements of all industry standard VITS and full field signals. Amplitude, phase, and timing parameters can all be determined quickly and accurately. With ANSWER you can make virtually every standard video measurement and have fast, automatic results.

ANSWER is designed for maximum versatility and testing power. The following special features give you quality measurement performance for a wide variety of applications:

Automatic measurements allow quick evaluation of VIT or full field signals

NTC 7 and FCC measurement routines provide detailed analysis of signal amplitude, phase, and timing

Simple display format means measurement results are easy to read and understand

User-definable measurement limits quickly identify an out-of-tolerance condition

Programmability accomodates present and future needs without additional hardware

Plus, RS-232-C interface compatibility adapts to almost any application of the broadcast plant, an unattended transmitter site, or even a common carrier satellite system

AUTOMATIC OPERATION

ANSWER is programmed with 37 individual measurements, many of which are combined into easy-to-use amplitude, phase, and timing routines. All of these operations are completely automatic and may be invoked using simple, one-word commands. You can tell ANSWER whether to run a whole measurement routine, a partial measurement routine, or a single measurement — periodically or on command. Results are ready within minutes and offer a high repeatability you can depend on.

IN-SERVICE MEASUREMENTS

ANSWER measures virtually all signal parameters on an in-service basis. Many of these measurements, including timing, do not even require the presence of a VIT signal. This full in-service capability minimizes the need for out-of-service measurements, so time may be spent on maintaining the system rather than on isolating system problems.

However, if the need should arise for out-of-service monitoring, ANSWER is ready with measurements for field-time, long-time, and dynamic-gain distortions.

AMPLITUDE AND PHASE

ANSWER provides a complete set of amplitude and phase measurements for both NTC 7 and FCC. These measurements include such parameters as sync, burst, and bar amplitudes; differential gain and phase; and chrominance-luminance distortions. Routines are available for all standard VITS and full field signals. With ANSWER, you can be sure of your video transmission quality.

TIMING

Since amplitude and phase measurements alone do not tell you everything you need to know, ANSWER also provides a complete set of timing measurements. These measurements give you detailed information on synchronizing signal parameters. ANSWER will tell immediately if video signals are within legal limits.

COMPREHENSIVE DISPLAY FORMAT

ANSWER displays measurement solutions in a simple, straightforward manner. The final measurement printout indicates the types of measurement performed, the resultant data, and the units of measure. The printout heading, especially useful for documentation, tells you the exact date and time the measurements took place. At a glance, you see all pertinent parameters of the incoming video signal.

1980 ANSWER OPTION 01

USER-DEFINABLE MEASUREMENT LIMITS

Inner (caution) and outer (alarm) limits may be programmed for each measurement parameter. The limit-exceeded signal generated on ANSWER's display is in the form of asterisks. Either of these limit signals may be programmed to initiate data logging, and the outer limit signal may be programmed to activate user interface alarms. Limit files are linked to the input source, allowing different limit values for each source.

HIGH MEASUREMENT ACCURACY

ANSWER provides consistent measurement accuracy with high repeatability. Special features like signal offset and gain control, dither generation, and signal averaging minimize possible errors. These techniques reduce noise on the incoming signal and provide an effective resolution of 11 bits. This means you can use ANSWER for the most stringent measurement problems and have fast, accurate results.

PROGRAMMABILITY

Through simple BASIC language, you may program ANSWER for special measurement routines. This programmability, along with ANSWER's microprocessor control and ROM memory, give you extensive flexibility. Format or standards changes can be made without the expensive modifications or recalibrations associated with analog test equipment.

RS-232-C COMPATIBILITY

ANSWER has RS-232-C (ASCII coding) interface capability. This means ANSWER can be adapted to a wide range of applications, including unattended and remote systems and systems under computer control.

MEASUREMENT ROUTINES

All measurement accuracies specified are valid over the entire dynamic range with an unweighted signal to noise ratio of 46 dB on the incoming signal. All measurements, except those so indicated, may be made in-service.

The following measurement routines are factory programmed in ANSWER. These routines may be initiated with a remote RS-232-C ASCII compatible input device. Measurement of groups of parameters instead of a complete routine may be selected with the remote input device.

All measurement accuracies specified are valid over the entire dynamic range with an unweighted signal to noise ratio of 46 dB on the incoming signal. The following in-service measurements are factory programmed in ANSWER.

N.A. is "not applicable."

AMPLITUDE AND PHASE MEASUREMENTS

Measurement	Definition	VITS NTC 7	VITS FCC	Range/ Accuracy
Bar Amplitude	The line bar amplitude from blanking to the center point of the bar top. Expressed in IRE units.	X	X	30 to 130 IRE units/ ± 0.5 IRE
Sync Amplitude (VITS not required)	The sync pulse amplitude measured from blanking level to the center point of the sync pulse bottom. Expressed as a percentage of the line bar amplitude.			20 to 80 IRE units/ ± 0.5 IRE
Burst Amplitude (VITS not required)	The peak-to-peak amplitude of the color burst as measured at the center point. Expressed as a percentage of the line bar amplitude.			10 to 90 IRE units/ ± 0.5 IRE
Average Picture Level (VITS not required)	The average picture level of the signal during the frame preceding sampling. Expressed as a percentage of 100 IRE units.			– 20 to + 120% of 100 IRE/ ± 3%
Reference Black Level	The position of reference black level (setup) relative to blanking level. Expressed in IRE units.	VIR signal		– 20 to 130 IRE units/ ± 0.5 IRE
Line Time Distortion	The peak-to-peak amplitude change of the line bar top with the first and last one microsecond of the bar excluded. Expressed as a percentage of the line bar amplitude.	X	X	0 to 40%/ ± 0.5%
Pulse to Bar Ratio	The amplitude of the 2T Pulse. Expressed as a percentage of the line bar amplitude.	X	X	10 to 125%/ ± 0.5%
T Step Ringing	The maximum peak to peak amplitude of the ringing preceding or following the T step transitions of the line bar. Expressed as a percentage of the line bar amplitude.	X	2T instead of T	0 to 25%/ ± 2%
Relative Chroma Gain	2.5 times the amplitude of the nominal 40 IRE level of the third chrominance packet of the linearity signal. Expressed as a percentage of the line bar amplitude.	X	X	25 to 175%/ ± 0.5%
Relative Chroma Time	The time relationship between the luminance and chrominance components of the modulated pulse. Expressed in nanoseconds.	X	X	± 300 ns/ ± 10 ns
Amplitude/ Frequency	The amplitude of the multiburst frequency packets with the white flag normalized to 100 IRE units. Expressed as a percentage of the white flag amplitude.	X	X	0 to 120 IRE/ ± 1 IRE or ± 2%, whichever is greater
Luminance Non-Linearity	A comparison of the amplitude of the step transitions of the 5 step staircase signal. Expressed as the percentage difference between the largest and smallest step transitions.	X	X	0 to 50%/ ± 0.5%
Chrominance Non-Linear Gain	The chrominance amplitude change as a function of chrominance level with luminance held constant. The three level chrominance signal is used. Expressed in IRE units with the middle chroma level normalized to 40 IRE.	X	N.A.	20 IRE chroma, 5 to 35 IRE: 80 IRE chroma, 45 to 160 IRE/ ± 0.5 IRE
Chrominance Non-Linear Phase	The peak-to-peak chrominance phase shift as a function of chrominance amplitude with luminance held constant. Expressed in degrees.	X	N.A.	0 to 180°/ ± 1°
Differential Gain	The change in chrominance level as a function of luminance amplitude with chrominance held constant. Expressed as a percentage difference between the largest and smallest chrominance amplitude.	X	X	0 to 180%/ ±0.4%
Differential Phase	The change in chrominance phase as a function of luminance amplitude with chrominance held constant. Expressed as peak-to-peak phase shift in degrees.	X	X	0 to 180% ± 0.4°
Chrominance-Luminance Intermodulation	The change in luminance amplitude as a function of chrominance amplitude with the luminance held constant. The three level chrominance signal is used. Expressed as the IRE unit difference between the amplitude of the unmodulated luminance pedestal normalized to 50 IRE units and the amplitude of the luminance pedestal modulated with the 80 IRE chrominance level.	X	N.A.	0 to 50 IRE/ ± 0.5 IRE
Signal to Noise Ratio (VITS not required)	The ratio of the line bar amplitude (if bar present, else 100 IRE) to the unweighted RMS amplitude of the noise. Expressed in dB			26 to 72 dB/ within 1 dB
Low Frequency Periodic Noise (VITS not required)	The ratio of the line bar amplitude (if bar present, else 100 IRE) to the peak-to-peak amplitude of the low frequency noise < 1 kHz (including field tilt and hum). Expressed in dB.			0 to 60 dB/ within 1 dB
Relative Burst Gain	The amplitude relationship of the color burst to the blanking level staircase chrominance packet. Expressed as the percentage difference of the above.	X	X	± 50%/ ± 0.5%
Relative Burst Phase	The phase relationship of the color burst and the blanking level staircase chrominance riser. Expressed in degrees.	X	X	± 180°/ ± 0.4°

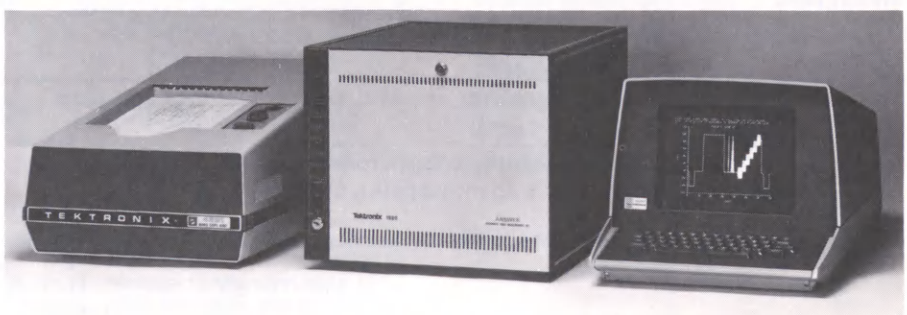
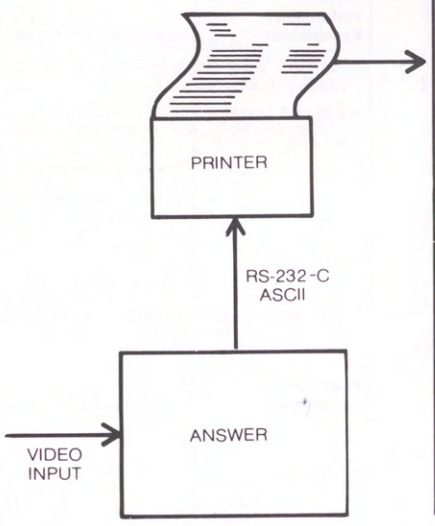


Figure 1. With a terminal, you can operate and program ANSWER and monitor the incoming video signal. The added capabilities of a hard-copy unit then let you obtain permanent records of both the signal and its resultant measurement parameters.

AUTOMATIC VIDEO MEASUREMENT SET



Sample Print-out of a Measurement Routine.

```
                          (REPORT)
STATION NAME                                        20-NOV-79 01:14:24
                        FCC  H. TIMING
                                          SOURCE: A0 (CHANNEL A)
                                          SYNC:   INTA
APL =  17 % (IRE)                                 VIOLATED LIMITS
                                                  LOWER     UPPER
H. BLANK 4          10.81  USEC
SYNC WIDTH           4.82  USEC
SYNC RISETIME      140.0   NSEC
SYNC FALLTIME      140.0   NSEC
SYNC-BRST END        7.9   USEC
SYNC-SETUP           9.03  USEC          **      9.21    1000.0
FRONT PORCH          1.78  USEC
BREEZEWAY             .6   USEC
BURST WIDTH          9.0   CYCLES

STATION NAME                                        20-NOV-79 01:14:50
                        FCC  V. TIMING
                                          SOURCE: A0 (CHANNEL A)
                                          SYNC:   INTA
APL =  27 % (IRE)                                 VIOLATED LIMITS
                                                  LOWER     UPPER
V. BLANK F1         20.1   LINES
V. BLANK F2         19.7   LINES
EQUALIZER WIDTH      2.38  USEC          **      2.54    1000.0
SERRATION WIDTH      4.78  USEC
```

IN ADDITION TO THE ABOVE IN-SERVICE MEASUREMENTS, THE FOLLOWING OUT-OF-SERVICE NTC 7 MEASUREMENTS MAY BE PERFORMED WITH ANSWER.

Measurement	Definition	VITS NTC 7	VITS FCC	Range/Accuracy
Field Time Distortion	The peak-to-peak amplitude change of the field square-wave top with the center point set to 100 IRE. The first and last 250 μs are excluded. Expressed as a percentage of the field square-wave amplitude.	Out of service		0 to 40%/ ± 0.5%
Long Time Distortion	See NTC Report 7. Flat field automatic bounce test signal is used. Expressed in IRE units and seconds.	Out of service		Overshoot range: 20 to 100 IRE units/ ± 1.0 IRE units. Setting time: 0.1 to 30 seconds/ ± 2% of bounce rate.
Dynamic Gain Distortion	See NTC Report 7. Flat Field test signal with selectable APL is used. Expressed as a percentage of line bar and sync amplitude at 50% APL.	Out of service		Picture gain range: − 25% to + 25%/ ± 1.0 IRE. Sync gain range: − 25% to + 25%/ ± 1.0 IRE.

THE FOLLOWING MEASUREMENTS MAY BE MADE AT THE DEMODULATOR OUTPUT WHEN THE CARRIER REFERENCE PULSE IS PRESENT.

Blanking Level (VITS not required)	The position of blanking with respect to zero carrier. Expressed as a percent of the vision carrier.			65 to 85% of maxiumum carrier/ ± 0.5%
Reference White Level	The position of the line bar top with respect to zero carrier. Expressed as a percent of the vision carrier.	X	X	2.5 to 22.5% of maximum carrier/ ± 0.5%

FCC AND RS-170A TIMING MEASUREMENTS

For all timing measurements, blanking level is 0 IRE. VITS are not required for timing measurements. RS-170-A information, where different, is given in parentheses.

Measurement	Definition	Range/Accuracy
H Sync Width	Measured between − 4 (− 20) IRE points on the leading and trailing edges of H sync. Expressed in μs.	1 to 8 μs/ ± 25 (± 15) ns
Front Porch Duration	Measured from the + 4 IRE point on the trailing edge of setup to the − 4 (− 20) IRE point on the leading edge of H sync. Expressed in μs.	0.5 to 2 μs/ ± 25 (± 20) ns
Sync to Start of Video Duration	Measured from the − 4 (− 20) IRE point on the leading edge of H sync to the + 4 IRE point on the trailing edge of blanking. Expressed in μs.	8 to 15 μs/ ± 25 (± 20) ns
Sync to Burst Start Duration	Measured from the − 20 IRE point on the leading edge of H sync to the leading zero crossing of the first burst excursion exceeding 50% of the burst amplitude.	4 to 30 cycles/ ± 20°
Sync to End of Burst Duration	Measured from the − 4 IRE point on the leading edge of H sync to the trailing zero crossing of the last burst exceeding 50% of the burst amplitude. Expressed in μs.	6 to 15 μs/ ± 20 ns ± 0.05 burst cycle
H Blanking Width	Measured between the ± 4 (± 20) IRE points on the leading and trailing edges of blanking. Expressed in μs.	8 to 30 μs ± 25 (± 50) ns
Color Burst Width	Measured from the leading zero crossing of the first burst excursion exceeding 50% of the burst amplitude to the trailing zero crossing of the last burst excursion exceeding 50% of the burst amplitude. Expressed in cycles.	6 to 13 cycles/ ± cycle, amplitude detection ± 0.5 IRE
Breezway Width	Measured from the − 4 IRE point on the trailing edge of H sync to the leading zero crossing of the first burst excursion exceeding 50% of the burst amplitude. Expressed in μs.	− 2.0 to 3.5 μs, T_0 is the − 4 IRE point on the trailing edge of H Sync/ ± 25 ns ± 0.5 burst cycle
H Sync Rise and Fall Times	Measured between the 10% and 90% points on the H sync edges. Expressed in μs.	0.31 to 1.0 μs/ ± 30 ns 0.14 to 0.3 μs/ ± 20 ns
Equalizing Pulse Width	Measured between − 4 (− 20) IRE points on the equalizing pulse. Expressed in μs.	1 to 20 μs/ ± 25 (± 15) ns
Serration Width	Measured between the − 4 (− 20) IRE points on the serration.	1 to 20 μs/ ± 25 (± 15) ns
Vertical Blanking Width	Measured between the 20 IRE vertical blanking edges. Expressed in lines.	20 to 50 lines/ ± 140 ns

1980 ANSWER AUTOMATIC VIDEO MEASUREMENT SET

SPECIFICATIONS

Signal Handling — Video Channels

Characteristics	Performance Requirement	Supplemental Information
Inputs		A and B (user selectable)
Impedance	75 Ω	
Return Loss	Video: ≥ 46 dB to 5 MHz Sync: ≥ 40 dB to 5 MHz	
Signal Level	0.5 to 2 V p-p	Sync negative
Coupling		Dc or ac nonfloating (user selectable)
Clamp		
Speed		Fast, slow, or off (user selectable)
Level		Sync tip or back-porch (user selectable)
Hum Rejection		
Fast	≥ 36 dB	
Slow	≥ 1 dB	
Signal Averaging		
Noise Reduction	≥ 14 dB	With 32 line averaging and an unweighted signal-to-noise ratio of 46 dB or less on the input signal.
Dynamic Range	2.5 V max.	With 2.5:1 video to sync ratio and input signal centered in the A/D converter dynamic range.
Gain Range	0-15.5 times	In 0.5 increments
Offset Range	0 to 248 LSB ±0.5 LSB (8 LSB increments)	Referred to input at unit gain
Noise Floor	−72 dB	0 dB = 714 mV
Distortions		
Differential Gain Error	≤ 0.5%	
Differential Phase Error	≤ 0.4°	
Luminance Non-Linearity Error	≤ 1.0%	
Amplitude/Frequency Error		
0 to 5 MHz	0 dB ±0.25 dB	
7.16 MHz	≥ −46 dB	
Delay Frequency Error		
0 to 5 MHz	≤ 10 ns	

Synchronization

Characteristics	Performance Requirement	Supplemental Information
Modes		
Internal	Satisfactory operation with 26 dB signal-to-noise ratio (Sound-in-Syncs disabled)	Channels A and B (user selectable)
External		Channels A and B (user selectable)
Amplitudes		
Internal	143 mV (20 IRE) min	Negative going sync on incoming signal.
External		
Minimum	0.2 V p-p into 75 Ω	composite sync
Maximum	8.0 V p-p into 75 Ω	composite sync

Analog to Digital Conversion

Characteristics	Performance Requirement	Supplemental Information
Resolution	8 bits	11 bits effective with dither.
Accuracy		
RMS	±0.25 LSB (±0.1%)	(LSB = least significant bit)
Peak	±0.5 LSB (±0.2%)	
Conversion Rate		20 MHz (maximum)
Monotonicity		All 256 codes present and in sequence with no polarity reversals.
Sampling Rate		
NTSC		910 x horizontal frequency.

NOTE: User selectable means that the function is controlled from the keyboard.

Digital Processing

Characteristics	Performance Requirement	Supplemental Information
Signal Memory		
Video Acquisition Memory Capacity	32k Samples	
Video Acquistion Memory Controller		
Sampling Modes		Line rate, field rate or block sampling between 2 points on signal.
Picture Monitor Bright-up Pulse Output		
Amplitude		≈ 240 mV
Termination		Internal in 75 Ω
Save Value	Multiples of 8	
Skip Value	Multiples of 2	
Real Time Clock		
Internal		
Reference Accuracy	10 ppm	Crystal Controlled
External		
Input Frequency		1 MHz
Input Amplitude	0.3 - 4.0 V	
Microcomputer		
Processor		TMS9900
User Memory	32k words	
Nonvolatile Memory	8k words	
Software Control		Tek ANSWER BASIC

Digital Interface

Characteristics	Performance Requirement	Supplemental Information
Access Ports		
Interface	RS-232-C	ASCII Code
Number	5	3 DCE* (Full Duplex). 2 DTE* (Full Duplex).
Baud Rate		
Port 0 (DCE)*	75 to 9600	User selectable with internal jumper placement.
Ports 1-4	75 to 9600	User programmable.
Automatic Call-up		RS-366 (Optional).
User Operation		Via Keyboard (ASCII)

*DCE = Data Communication Equipment
*DTE = Data Terminal Equipment

1980 ANSWER OPTION 01 AUTOMATIC VIDEO MEASUREMENT SET

MEASUREMENT LIMITS

Inner Limits —Two per measurement.

Outer Limits — Two per measurement.

Limits Values — Default values standard. Other user defined limits may be stored in non-volatile memory. Limits may be linked to input source.

Limits Memory Required — Eight words per set of four limits.

Limits Outputs — To the selected RS-232-C port(s).

Front Panel Indicators — LED Indicators

- Battery Failure
- I/O Failure
- Sampling in Progress
- Busy

ENVIRONMENTAL DATA

Characteristic	Performance Requirement	Metric
Temperature		
Storage	– 40 to + 65 °C.	
Operating	0 to + 50 °C.	
Altitude		
Storage	To 50,000 feet.	15,240 m
Operating	To 15,000 feet.	4,572 m

DIMENSIONS AND WEIGHTS

	Cabinet		Rackmount	
	in	cm	in	cm
Height	13.97	35.48	13.97	35.48
Width	16.88	42.88	18.98	48.26
Length	23.36	59.33	22.04*	64.41
	lb	kg	lb	kg
Shipping	≈ 55	≈ 25	≈ 55	≈ 25

*Measured from back of front sub-panel to rear of instrument.

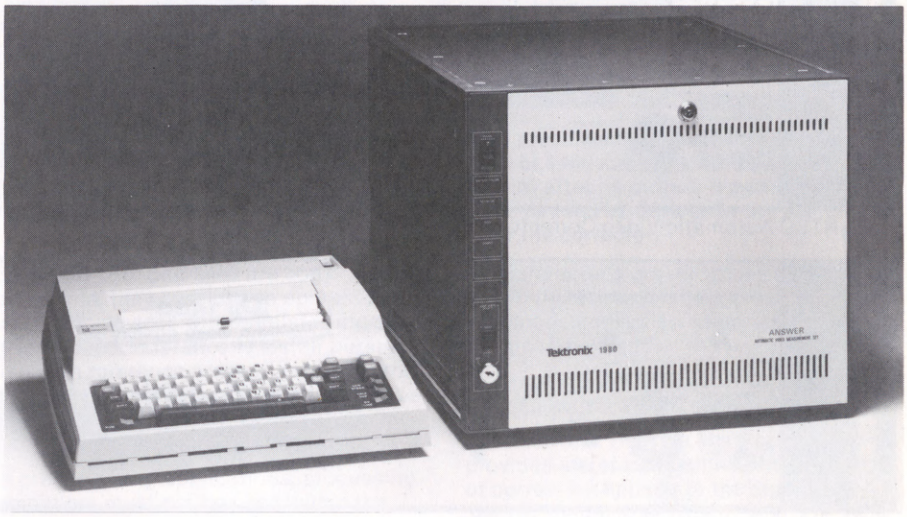


Figure 2. With a simple keyboard/printer, you can operate and program ANSWER and obtain permanent records of measurement results.

ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

1980 ANSWER

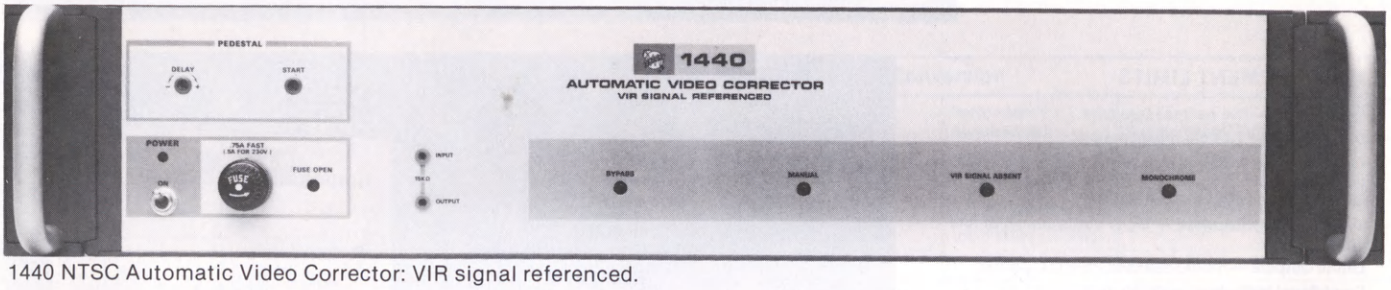
Option 01: NTSC Applications Software*

Option 12: Automatic Call Equipment

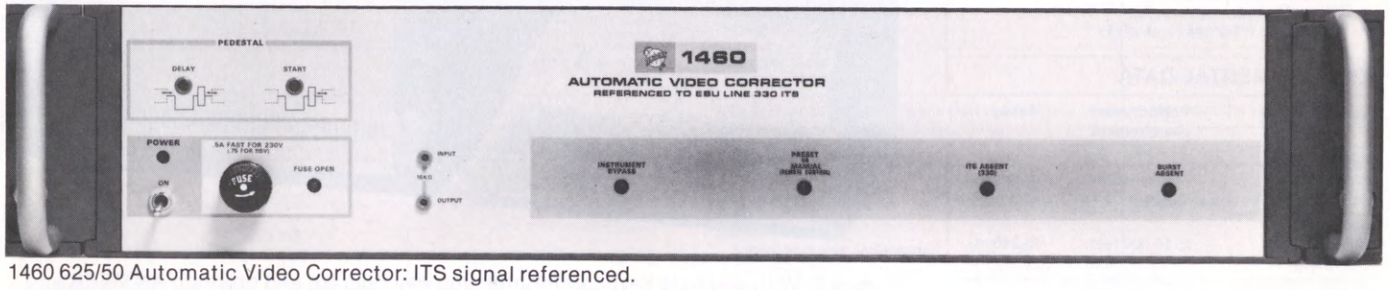
*Option 01 is required.

ANSWER requires the use of a terminal for display. We offer several including the CT8101 Printing Terminal, the 4006-1 11 inch CRT Graphics Terminal, the 4014-1 19 inch CRT Graphics Terminal, and the 4025 12 inch Raster Scan CRT Terminal, also with graphics. We also offer the 4631 Hard Copy Unit for clean, dry, hard copies.

1440/1460 AUTOMATIC VIDEO CORRECTORS



1440 NTSC Automatic Video Corrector: VIR signal referenced.



1460 625/50 Automatic Video Corrector: ITS signal referenced.

Reduce operating costs

Extend transmitter tube life and reduce maintenance costs

Maintain consistent high quality color pictures

Automate transmitter modulation level control

Maintain correct sync to video ratios during line voltage fluctuations or when power level is adjusted

Automatic VIRS or ITS-referenced correction of:
- **Overall video signal amplitude**
- **Chrominance to luminance gain ratio**
- **Black level**
- **Chrominance phase**
- **Burst gain**
- **Sync gain**

Sync and burst regeneration (optional) (1440 only)

White clip with automatic clip level tracking (optional) (1440 only)

Optional closed loop capabilities for greater efficiency and economy in transmitter and VTR operations

The 1440 and 1460 Automatic Video Correctors give fully automatic correction of video gain, chrominance to luminance gain ratio, black level (set up), chroma phase, burst amplitude, and sync amplitude errors. With either of these two correctors in your facility, the quality of the program signal is rigidly maintained. Ordinary changes and even many severe distortions are automatically corrected.

The Tektronix 1440

The 1440 VIRS Automatic Video Corrector is an in-line NTSC processing amplifier that uses the VIRS (Vertical Interval Reference Signal) to automatically correct video gain, chominance to luminance gain ratio, setup level, burst phase relative to chroma (hue), burst gain, and sync gain.

Video gain correction is referenced to the 50 IRE level of the VIRS. Chrominance to luminance gain ratio and burst phase corrections are referenced to the amplitude and phase of the VIRS chrominance respectively. Setup level correction is referenced to the 7.5 IRE level of the VIRS. Sync and burst gain corrections are controlled respective to their standard amplitudes.

The Tektronix 1460

The 1460 Automatic Video Corrector is an in-line PAL processing amplifier. It uses the EBU Line 330 Insertion Test Signal (ITS) as a reference to automatically correct video gain, chrominance to luminance gain ratio, black level, chroma phase, burst amplitude, and sync amplitude.

The 1460 samples peak of white bar for overall video gain correction. Blanking level is sampled for black level correction. The third, fourth, and fifth chrominance risers are sampled for chroma gain and chroma phase correction. Sync and burst are sampled and corrected to their standard 300 mV amplitudes.

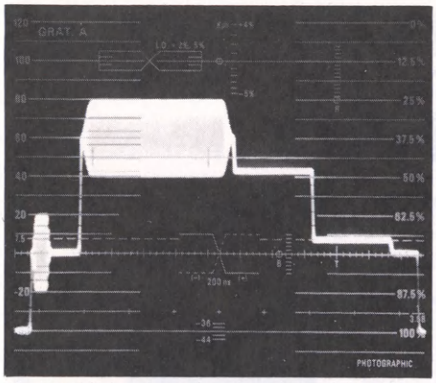
APPLICATIONS

Broadcast
- On the network feed
- On remote feeds into the plant
- At the master switcher output
- At the transmitter input

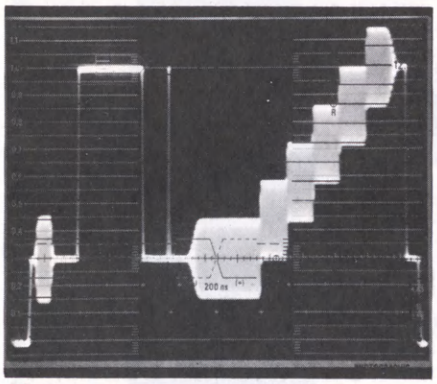
Cable
- In local origination
  Where imported signals are demodulated to baseband before modulation onto a new carrier

Satellite Systems
- Correction of video signals at transcoding points, to and from different color systems

Television Receiver Design
- Changing burst gain and introducing burst-phase errors for testing automatic color control circuits



Vertical interval reference signal (VIRS)



EBU insertion test signal line 330

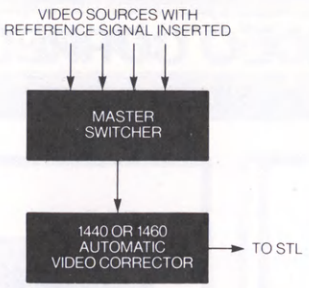
AUTOMATIC CORRECTION

Automatic Video Correctors sample six parameters of the reference signal in the vertical interval and then automatically change their operating characteristics until correct values for the Reference Signal are achieved. Distortions in the full field signal are simultaneously corrected by the automatic changes that restore the Reference Signal to its original characteristics. The corrector has no front or rear panel controls other than the power switch and the preset pedestal width adjustments. Operating modes other than full automatic correction are indicated by front panel lights. Oscilloscope test points are provided for program input and program output.

PROGRAM PROTECTION AND OPERATING CONSIDERATIONS

In most cases the automatic operation is straightforward. Reference signal distortions will cause correcting action to occur.

Open loop operation



As a corrector (open loop) — the 1440 or 1460 monitors the video signal at its program line input and automatically corrects distortions.

Since the 1440 and 1460 are both automatic, they continue to operate as unity gain devices without distorting program video if reference is lost. If burst is lost with reference present, monochrome correcting continues. An excellent source of reference is the 1441 for NTSC Systems, or 1461 for PAL Systems.

In precorrecting applications, processing amplifiers must not be used within the loop.

When sound-in-syncs is present, automatic sync correction can be disabled. Manual control of sync gain can be substituted with the Remote Control Unit.

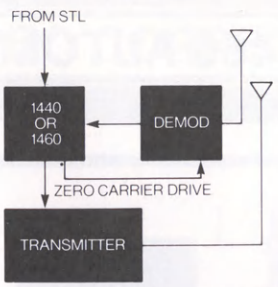
A bypass relay located in the corrector interface unit ensures continuity of the program line through the Automatic Corrector. The relay automatically bypasses the program line to maintain a constant program delay line in the event of a power failure. The remote control unit can also activate this bypass relay. The program delay in all modes is 145 ns.

The 1440 and 1460 may be removed from their equipment racks with minimum instantaneous disruption of the program line and with no observable time difference between the corrected or bypassed signal.

AUXILIARY UNITS

In most applications, the usefulness of automatic correction is enhanced by a Tektronix Remote Control Unit. You can conveniently select corrector modes and manually correct six signal parameters with this unit. With simple internal changes in the Corrector, you can manually select individual parameters while automatic correction of the other parameters remains operational. The remote unit allows easy adjustment of

Closed loop operation



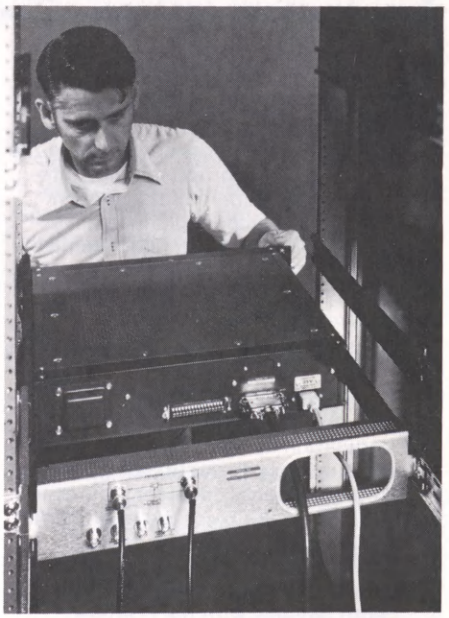
As a precorrector (closed loop) — The 1440 or 1460 monitors the video signal at a point after its output. It corrects distortions caused by devices in the signal path after the corrector.

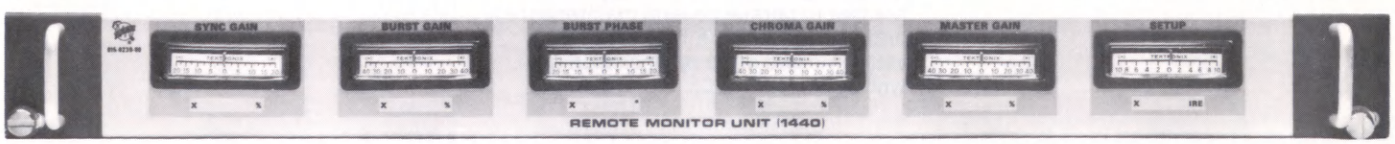
the parameter's preset values for operation in the absence of a reference signal. Automatic correction value adjustment are also provided.

For use with the 1440 order 015-0240-00. For use with the 1460 order 015-0240-01.

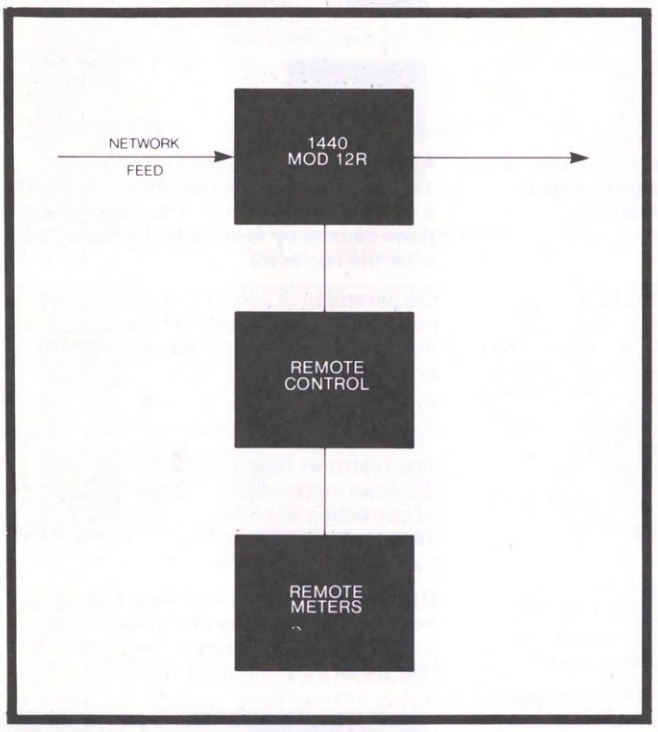
The Tektronix Remote Monitoring Unit provides meter indications of the amount of correction applied to the signal. For 1440 systems order 015-0239-00. For 1460 systems order 015-0239-01.

Distortion recording over long periods is possible with the use of a commercially available chart recorder driven from the rear panel outputs of the corrector.

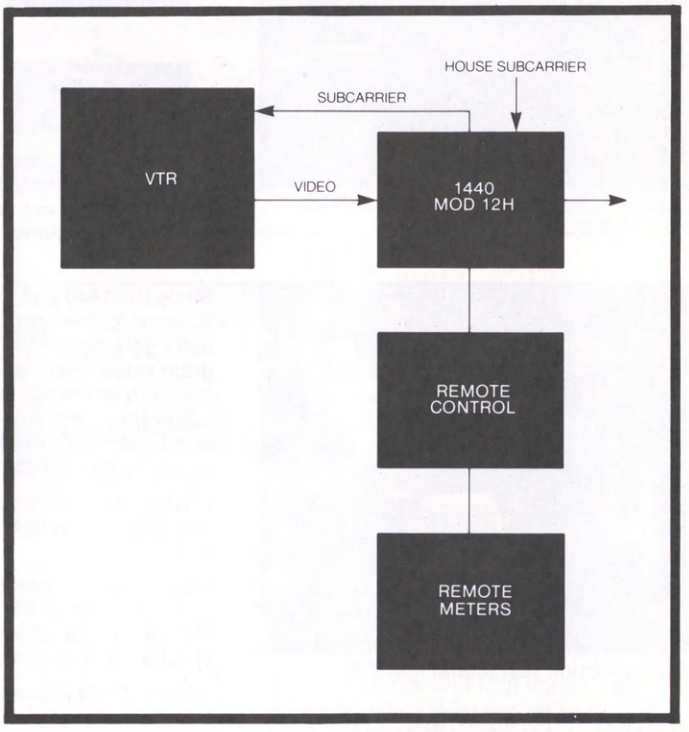




1440/1460 AUTOMATIC VIDEO CORRECTORS



Network and remote feeds



VTR control

NETWORK AND REMOTE FEEDS

With the major networks now sending the VIR signal on most programming, automatic video correction on the network feed into the broadcast plant deserves serious consideration. Here are some of the things a 1440 Modification I2R (sync and burst regeneration) on the network feed can do for you.

- Eliminate hum and field time distortions
- Regenerate sync and burst
- Help eliminate transmitter overmodulation by locally inserted VIT signals due to the action of AGC units
- Prepare the network signal for recertification (deletion of the existing VIR signal and the addition of a locally generated VIR signal) to insure that control over transmitter modulation depth remains with the licensee

This is primarily important where transmitter modulation is under the control of a VIRS controlled automatic video corrector such as the Tektronix 1440.

You can also use the 1440 Modification I2R on remote feeds to eliminate long time distortions and bounce while simultaneously providing automatic video signal correction.

VTR CONTROL

Lets you:

- Eliminate hue and saturation differences that can occur between various segments of an assembled program
- Insure proper setting of VTR burst phase and video gain controls on all playbacks

The 1440, used at your VTR, can help you do all of this automatically. Our 1440 Modification I2H is equipped with a subcarrier phase shifter that allows the 1440 to make chroma phase corrections without upsetting studio timing. The remaining five corrections are all made in the normal open loop manner.

Automatic video correction can streamline your VTR operations.

1440 AT TRANSMITTER SITE

Use the 1440 in a closed loop mode around a TV transmitter for unattended transmitter operation. The 1440 automatically maintains proper modulation levels and ratios under even the most extreme cases of line voltage or power fluctuation. The need for constant monitoring and manual adjustment of sync and video levels is gone, and operating personnel are free to pursue general maintenance and other tasks. The 1440 is available with sync and burst regeneration and white clip (MOD I3C).

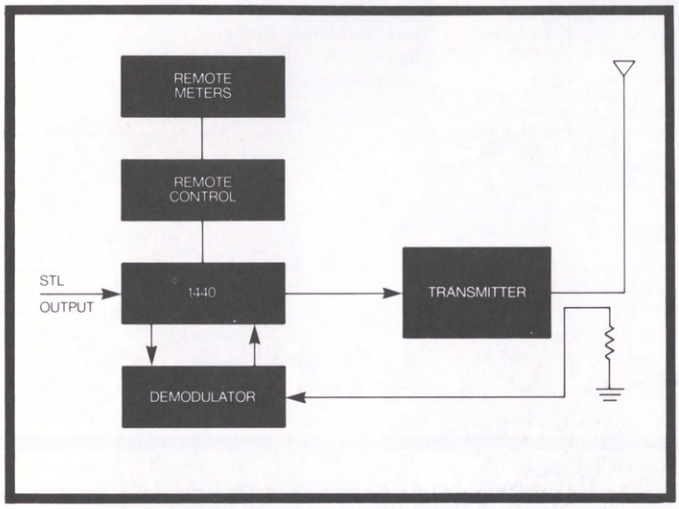
1440 AT REMOTE SITE

This application is very similar to the previously described transmitter control mode with the 1440 at the transmitter site, except the STL (studio transmitter link) is also now under the control of the 1440. Using transmitter control with the 1440 at the remote site gives two additional benefits:

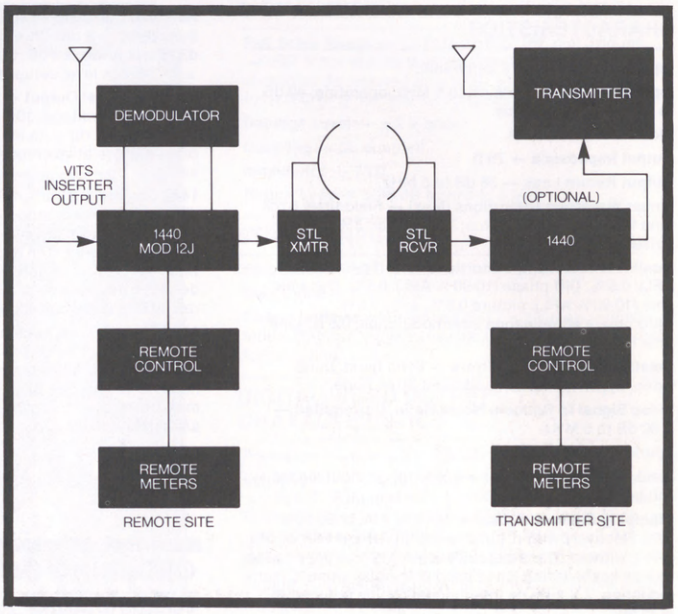
- The 1440 can now compensate for distortions occuring in the STL.
- Control of the 1440 operating modes is now at the remote site, an important consideration when running an unattended transmitter.

If in this mode of operation the required transmitter correction causes the 1440 to overdrive the STL microwave, a second 1440 or a comparable manual proc amp may be employed at the transmitter site. This 1440 would be operated in the manual mode and would be adjusted (with the Remote Control Unit) to allow the 1440 Mod I2J at the remote site to operate as an "automatic trimmer" for the entire system.

1440/1460 AUTOMATIC VIDEO CORRECTORS



1440 at transmitter site



1440 at remote site

The RF path between the transmitter site and the remote site is an important consideration in long distance automatic transmitter control. In you are considering this for your operations, we recommend you try a 1440 Modification I2J for a short period of time to insure its successful incorporation into your system.

VIRS CONTROLLED HOME RECEIVERS

The 1440 has many useful and important applications in all areas of the broadcast plant. Applications which, in the long run, save you time and money while improving your picture quality.

With VIRS controlled receivers now being introduced, you have a dual opportunity to improve your station's image. Using VIRS and the 1440, you transmit the best possible picture. And with program certified by VIRS, viewers with VIRS controlled receivers can enjoy the benefits of automatic video signal correction in their home.

Whatever your needs, Tektronix has a total line of VIRS generators and VIRS referenced automatic video correctors ready to serve you.

Application	Recommended Product
Closed loop around the transmitter; 1440 at the transmitter site	1. Standard 1440 2. 1440 Mod I2R — add sync and burst regeneration. 3. 1440 Mod I3A — add white clip. 4. 1440 Mod I3C — add sync and burst regeneration and white clip.
Closed loop around the transmitter: 1440 at a remote site	1. 1440 Mod I2 J — add long loop delay. 2. 1440 Mod I3D — add long loop delay and sync and burst regeneration. 3. 1440 Mod I3B — add long loop delay, sync and burst regeneration, white clip.
At the network feed or remote feeds into the plant	1. Standard 1440 2. 1440 Mod I2R — add sync and burst regeneration.
At the VTR output	1. 1440 Mod I2H — external subcarrier input to allow 1440 to maintain studio timing.

ORDERING INFORMATION

1440

1440 Mod I2H — external subcarrier input.

1440 Mod I2J — long loop delay.

*1440 Mod I2R — Sync and burst regeneration.

1440 Mod I3A — White clip.

*1440 Mod I3B — Sync and burst regeneration, white clip, long loop delay.

*1440 Mod I3C — Sync and burst regeneration and white clip.

*1440 Mod I3D — Sync and burst regeneration and long loop delay

*Remote Control Unit Included.

All modifications require a quotation.

Application Notes Available

TV #8 Using The Vertical Interval Reference Signal

TV #8A TV Transmitter Precorrection With The Tektronix 1440

1440/1460 AUTOMATIC VIDEO CORRECTORS

CHARACTERISTICS

Input Impedance — 75 Ω nominal.

Input Return Loss — 46 dB to 5 MHz, operating; 40 dB to 5 MHz, bypass mode.

Video Delay — 145 ns.

Output Impedance — 75 Ω.

Output Return Loss — 36 dB to 5 MHz.

Linear Waveform Distortions (Max) — Field time: 0.5%. Line time: 0.5%. Short time: T pulse/bar: 2%. 2T pulse/bar: 1%.

Nonlinear Waveform Distortions — Diff gain (10-90% APL): 0.5%. Diff phase (10-90% APL): 0.5%. Dynamic gain (10-90% APL): picture 0.5%, sync 0.5%. Chrominance/luminance intermodulation: 0.5%. Line time nonlinearity: 0.5%.

Relative Signal Timing Errors — Sync-burst, burst video, sync-video jitter, and burst jitter: none.

Video Signal to Random Noise Ratio, Unweighted — ≥60 dB to 5 MHz.

Spurious Subcarrier — −60 dB.

Field Time Tilt Correction — 25% tilt on input signal — will be reduced to ≤1%.

Clamping Characteristics — 10-90% APL or 90-10% APL. Recovery within 1 line to within 5 IRE (1440), or 5% (1460) without overshoot. Slow clamp option provided to reduce keyboarding when used with noisy signals. Hum reduction: 1 V hum on input signal can be reduced to ≤25 mV.

Maxiumum Correction Ranges — Video level at input: ±6 dB. Sync level at input: ±3 dB. Chrominance/luminance gain: ±3 dB. Burst level: ±6 dB. Burst/chrominance phase: ±25°. Black level setup: 1440 ±10 IRE, 1460 ±70 mV.

Reduced Correction Ranges — Video level: ±2 dB. Sync level: ±3 dB. Chrominance/luminance gain: ±3 dB. Burst level: ±3 dB. Burst/chrominance phase: ±25°. Black level setup: 1440 ±5 IRE, 1460 ±35 mV.

Dc Error-Signal Output — Source impedance: 10 kΩ. Open circuit voltage: 10 V for remote metering and telemetry. Six outputs including: video gain, sync gain, burst gain, relative chroma gain, burst phase, and setup.

1440 Chroma/luminance Gain Correction (+3 dB to −3 dB) −2T pulse/bar ratio — 110% max and 92% min T. Pulse/bar ratio: 125% max and 85% min 2T pulse preshoot: 5% max. T step overshoot: 5% max. T step rise time: 95 ns min and 155 ns max. Chroma/luminance delay: 10 ns min and 10 ns max. VIR signal correction rate: 0.03 s (90% correction without overshoot).

1460 Chrominance/luminance Gain Correction (+3 dB to −3 dB) — 2T pulse/bar ratio: 115% and 88%. T pulse/bar ratio: 128% and 82%. T step rise time: 80 ns min and 120 ns max 2T pulse preshoot or overshoot: 7% max T step overshoot: 8% max. Chrominance/luminance delay: 10 ns max.

POWER SUPPLY

Line Voltage Range — 115 V ac ±10% and 230 V ac ±10%.

Crest factor — ≥1.35.

Max Line Current — 0.5 A.

Max Power Consumption — 35 W.

Line Frequency Range — 48 to 66 Hz.

DIMENSIONS AND WEIGHTS

	in	cm
Length	16.22	41.20
Width	19.00	48.26
Height	3.47	8.81
	lb	**kg**
Net	16.69	7.57
Domestic Shipping	24.14	10.95
Export Shipping	37.00	16.78

ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

1440 NTSC Automatic Video Corrector

1460 625/50 Automatic Video Corrector

OPTIONAL ACCESSORIES

015-0240-00 Remote Control Unit for 1440
(Includes 2 connectors)

015-0239-00 Remote Monitor Unit for 1440
(Includes 1 connector)

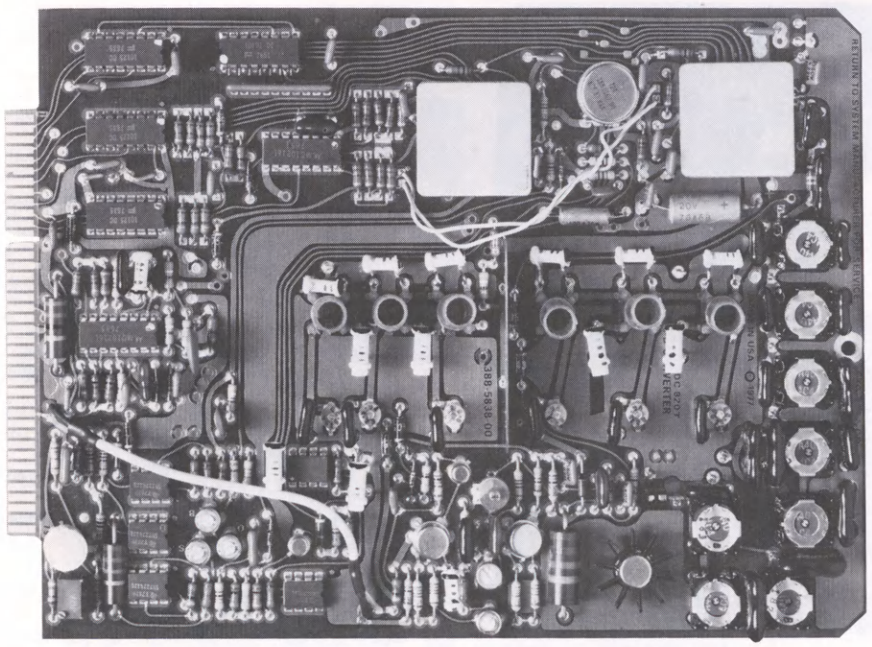
015-0240-01 Remote Control Unit for 1460
(Includes 1 connector)

015-0239-01 Remote Monitor Unit for 1460
(Includes 1 connector)

012-0131-00 6 Foot Extender Cable with connectors for use between the 1440 or 1460 and the remote control and remote monitor units.

012-0637-00 3 Foot Extender Cable with connectors, for use between the 1440 or 1460 chassis and the rear rack-mounting section.

ADC 820 ANALOG TO DIGITAL CONVERTER



Available in Both ECL- and TTL-Compatible Versions

Speed — capable of sampling at up to 20 Megasamples/second

Accuracy — differential phase and gain of ½ ° and 1%; linearity better than ± ½ LSB

Reliability — all semiconductors pre-aged both individually and on the board

Power — <7 watts

Size — 6 x 8 x 1.125 in., a single circuit board

The Tektronix ADC 820 is an 8 bit, 20 MHz analog to digital converter, optimized for digital video processing and designed for OEM applications in video, radar, and communications equipment.

The ADC 820 is distinctive for its high speed, excellent resolution and accuracy, low power consumption, high reliability, and construction simplicity. Monotonicity of the output word is guaranteed.

The ADC 820 consists of a single 6 in. x 8 in. circuit board with a dual 40-contact edge connector having 0.1 in. spacing. No parts project more than 1.125 in. above the board. UL-approved materials and processes are used to manufacture the board.

Important Note: Specifications for the ECL-compatible version are shown in brackets [ ] where they differ from specifications for the TTL-compatible version. Where only a single specification is given, it applies to both versions.

CHARACTERISTICS

Resolution — 8 bits (0.4%).

Accuracy — Referred to a straight line through cut-points 14 and 239. (Cut-point n is defined as the voltage at which it is equally probable that the output word will be n or n + 1.) RMS: ± 0.25 LSB (± 0.1%)

Conversion Rate — 20 Mega-samples/s.

Monotonicity — All 256 codes present and in sequence.

AMPLITUDE

Frequency Response —

0 dB ± 0.15 dB; 0 to 5.2 MHz

≤ − 46 dB: 7.16 MHz ($2f_{SC}$ NTSC).

≤ − 46 dB: 8.86 MHz ($2f_{SC}$ PAL).

≤ − 40 dB: 10 MHz and above

DELAY

Constant ± 10 ns from 0 to 5.2 MHz

SIGNAL INPUT

Full Scale Range — 1.214 V p-p (170 IRE p-p) 0 count: − 0.607 V (for standard video signals the sync tip should be dc restored to − 0.607 V; a − 321 mV offset for NTSC or − 307 mV for PAL). 255 count: + 0.607 V.

Damage Level — ± 2 V max.

Coupling — Dc coupled.

Impedance — 75 Ω.

Return Loss — ≥ 46 dB from 0 to 5 MHz.

STROBE INPUT

Frequency — ≤ 20 MHz.

Duty Cycle — 0.4 to 0.6.

Characteristics — Balanced ECL, ± 1 V max common-mode. Onboard pulldowns (100 Ω to − 2 V) are provided for each line.

DIGITAL WORD OUTPUT CHARACTERISTICS

Format — Parallel 8 bit straight binary.

Logic Level — TTL-compatible High = 2.4 to 5 V. Low = 0 to 4 V. (Balanced ECL 10,000 series, open emitter. With outputs externally loaded 50 Ω to − 2.0 V; High = − 1.060 V to − 0.700 V; Low = − 1.89 V to − 1.615 V.)

Drive — Up to 10 standard TTL loads (820T only).

Timing — t_n is the rising edge of the clock pulse. MSBs (B4-B7): valid from t_n + 30 ns to t_n + 1 + 15 ns. LSBs (B0-B3): valid from t_n + 57 ns to t_n 1 + 37 ns. (t_n is the rising edge of the clock pulse. MSBs (B4-B7): valid from t_n + 1 + 15 ns to t_n + 1 + 6 ns. LSBs (B0-B3): valid from t_n + 57 ns to t_n + 1 + 40 ns.)

DATA AVAILABLE

Format — Two pulses (B0-B3 and B4-B7).

Timing — B4-B7; leading edge occurs at t_n + 10 ns. B0-B3. Leading edge occurs at t_n + 35 ns; pulse width: ≥ 20 ns.

Format — Single pulse.

Timing — Leading edge occurs at t_n + 36 ns.

Logic Level — TTL-compatible High = 2.4 V to 5 V. Low = 0.0 V to 0.4 V. (Balanced ECL 10,000 series, open emitter. With outputs externally loaded 50 Ω to − 2.0 V High = − 1.06 V to − 0.700 V; Low = − 1.890 V to − 1.615 V).

Drive — Up to 10 standard TTL loads (820T only).

POWER SUPPLY REQUIREMENTS

+ 12 V; + 12V ± 1.5% (11.82 V to 12.18 V) at 100 mA (can be 100 mA higher during the first 5 seconds after turn on). − 12 V; − 12 V ± 1.5% (11.82 V to − 12.18 V) at 120 mA (can be 100 mA higher during the first 5 s after turn on). + 5 V; + 5 B ± 5%. (4.75 V to 5.25 V) at 400 mA (at 250 mA). − 5.2 V. − 0.2 V ± 4% (− 5.4 V) at 500 mA (at 600 mA).

Power — ≤ 7 W

Connector — Dual 40-contact card edge; with 0.1 in. spacing.

Temperature Range — 0° to 60 °C.

Warmup Time — 3 minutes.

DIMENSIONS AND WEIGHTS

	in	cm
Length	6	15.24
Width	8	20.32
Height	1.125	2.85
	lb	**kg**
Net	0.584	0.295
Shipping	1.75	0.871

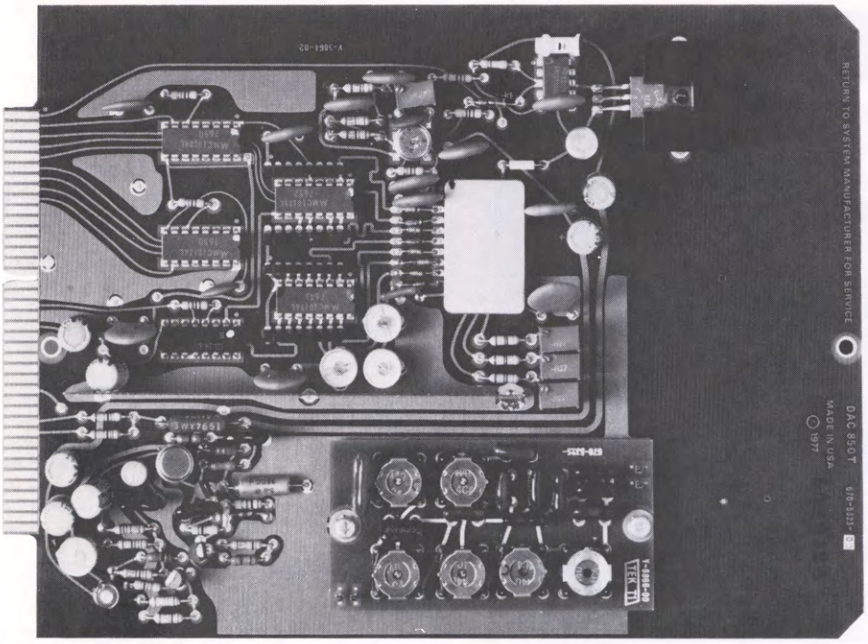
ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

ADC 820T Analog to Digital Converter (TTL outputs).

ADC 820E Analog to Digital Converter (ECL outputs).

DAC 850 DIGITAL TO ANALOG CONVERTER



Available in Both ECL- and TTL-Compatible Versions

Speed — capable of up to 50 MHz update rate. Allows a wide range of applications

Accuracy — differential phase and gain of 0.5° and 1% max. Ideal for video applications

Glitches — glitching is <5 ns/LSB

Reliability — all semiconductors pre-aged both individually and on the board

Output Amp — included on board, will drive two 75 Ω loads

Multiplying Capability — external reference input available

The Tektronix DAC 850 is an 8 bit digital to analog converter optimized for digital video processing. And with an input word rate of up to 50 MHz, it is ideal for use in video, radar, and communications equipment.

The advanced design of the DAC 850 provides a clean, monotonic analog signal without the usual "deglitching" output circuits of more conventional high-speed converters. The DAC 850 does not need to be "matched" to a specific analog-to-digital converter. The DAC 850 can also be used as a multiplying or external-referenced D/A converter.

The standard DAC 850 is supplied without a low pass filter and is suitable for those applications where a special user-supplied low-pass filter is desirable.

The Option 03 and Option 04 models are designed to operate at three and four times subcarrier respectively in the NTSC Color System, while the Option 13 and 14 models are designed to operate at three and four times subcarrier respectively in the PAL Color System. The DAC 850's low-pass filter and sin X/X-corrected output amplifier are flat over the video passband, assuring high picture quality.

Important Note: Specifications for the ECL-compatible version are shown in brackets [ ] where they differ from specifications for the TTL-compatible version. Where only a single specification is given, it applies to both versions.

FREQUENCY RESPONSE AND DELAY CHARACTERISTICS — DAC 850 E AND 850 T

Opt. 03	Opt. 04	Opt. 13	Opt. 14
0 dB ±0.2 dB; 0 to 3.6 MHz	0 dB ±0.2 dB; 0 to 5 MHz	0 dB ±0.2 dB; 0 to 5 MHz	0 dB ±0.2 dB; 0 to 6 MHz
≤ −3 dB; 5.37 MHz	≤ −3 dB; 7.16 MHz ($2f_{SC}$ NTSC)	≤3 dB; 6.65 MHz	≤3 dB; 8.8 MHz
≤ −42 dB; 7.5 MHz	≤ −42 dB; ≥10 MHz	≤42 dB; ≥9.3 MHz	≤42 dB; ≥12.4 MHz
Constant ±10 ns from 0 to 3.6 MHz	Constant ±10 ns from 0 to 5 MHz	Constant ±10 ns from 0 to 5 MHz	Constant ±10 ns from 0 to 6 MHz

CHARACTERISTICS

D/A CONVERSION (valid for Internal V_{ref} only)

Resolution — 8 bits (1 LSB = 0.4% of full scale). Accuracy (including linearity) ± ½ LSB (+0.2% of full scale).

Monotonicity — Guaranteed for 8 bits. Output polarity follows input code change.

Nonlinear Distortions — (at 40 IRE chroma at 4 xf_{SC}). Differential Gain — ≤0.75%, Options 04 and 14. ≤1%, Options 03 and 13. Differential Phase — ≤0.25°, Options 04 and 14; 0.5°, Option 03 and 13.

Noise — ≤ −67 dB to 5 MHz; ≤ −60 dB to 20 MHz.

DATA INPUTS

Format — 8 bit parallel, straight binary (BIN). (8 bit parallel, Straight binary (BIN) differential ECL inputs, terminated in 100 Ω.)

Logic — TTL compatible: High 2 V to 5.5 V; Low 0 V to 0.8 V. ECL-compatible: High −0.96 V to −0.81 V. Low −1.85 V to −1.65 V.

Setup Time — ≥7 ns before 50% point of leading edge of strobe pulse.

Hold Time — ≥1 ns after 50% point of leading edge of strobe pulse.

STROBE INPUT

Format — Differential ECL inputs, terminated in 100 Ω.

Logic — ECL High — 0.96 to −0.81 V: Low −1.85 to −1.65 V.

Up-date Rate — 50 MHz, max.

Minimum Pulse Width — 8 ns, and must end ≥8 ns before next pulse transition.

EXTERNAL REFERENCE INPUT (V_{ref} Multiplying Input)

V_{ref} for Normal Output — −5.66 V.

External Reference Gain — 350 mV/V full scale.

Frequency Response — Flat to 7.16 MHz (Option 04).

OUTPUT

Full Scale Range — 1.214 V p-p ±1% (adjustable).

Dc Offset — −286 mV ±50 mV (adjustable).

Offset Range — ≥100 mV.

Impedance — 75 Ω (2 outputs).

Return Loss — ≥30 dB

OTHER CHARACTERISTICS

Power Requirements — +12 V: +12 V dc ±1.5% (11.8 to 12.2 V) at 16 mA. −12 V: −12 V dc ±1.5% (−11.8 to +12.2 V) at 160 mA (200 mA). +5 V (Analog V 1): +5 V dc +5% (4.75 to 5.25 V) at 75 mA. +5 V (Digital V 2): +5 V dc +5% (4.75 to 5.25 V) at 125 mA (0 mA). −5.2 V: −5.2 V dc ±5% (−4.94 to −5.46 V) at 370 mA.

Power Consumption — ≤5.3 W. Size: 6 x 8 x 1 in.

Connector — Dual 40-contact card edge, with 0.1 in. spacing.

Temperature Range — 0° to 60°C.

Warmup Time — Allow 3 minutes.

ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

DAC 850T (without output lowpass filter)

DAC 850E (without output lowpass filter)

The following options are available for either the E or T version.

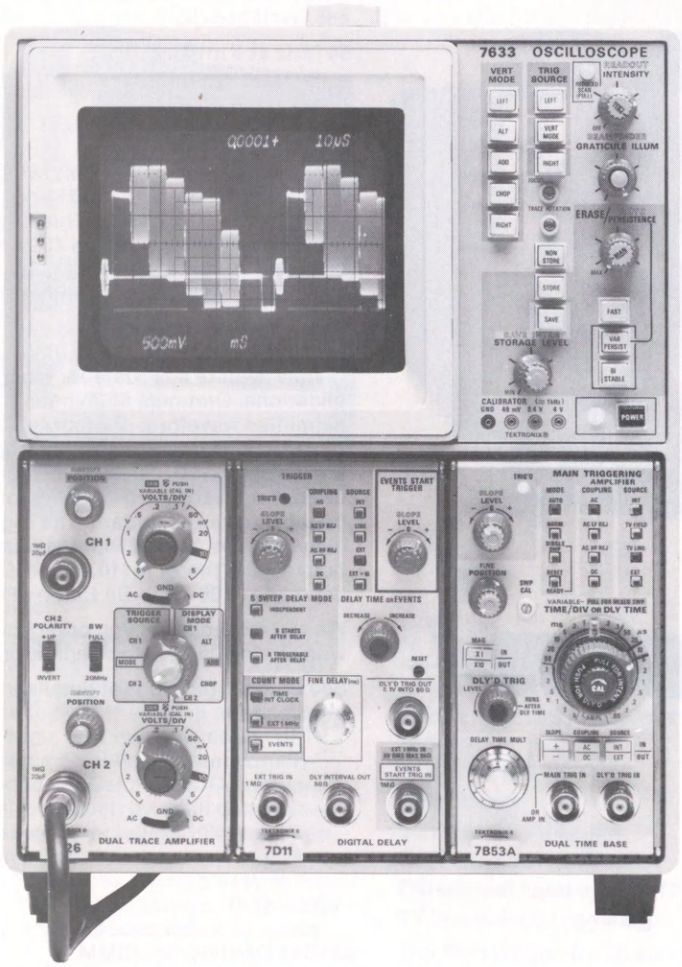
Option 03 ($3xf_{SC}$ NTSC output filter)

Option 04 ($4xf_{SC}$ NTSC output filter)

Option 13 ($3xf_{SC}$ PAL output filter)

Option 14 ($4xf_{SC}$ PAL output filter)

7000 SERIES OSCILLOSCOPES



The 7000 Series is a unique family of instruments that brings to the laboratory the ultimate in measurement technology.

Numerous measurement concepts — oscilloscopy, synergistic analog-digital measurements, spectrum analysis, sampling, time domain reflectometry, curve tracing — are fused into a family of interdependent CRT mainframes and instrument plug-ins.

You can tailor systems to fit your exact measurement needs. Mainframes in the family offer a choice of popular bandwidth ranges and a wide selection of additional features. Plug-ins — including oscilloscope vertical amplifiers and time bases as well as instruments for a variety of applications — can be selected to round out your tailored system.

For general purpose TV use, we suggest the 7000 Series Oscilloscope Package consisting of a 7633 Multimode Storage Mainframe, 7A18 Dual Trace Amplifier, and 7B53A Option 05 Timebase with TV Sync triggering.

Use the 7633 with the 1405 Sideband Analyzer.

7633 Basic System

- Multimode storage
- Dc to 75 MHz
- Two vertical channels — 5 mV/div sensitivity
- Dual time base — triggering to 100 MHz
- Fast writing speed for viewing very short low repetition rate events

7633 Mainframe only

- Single beam, multimode storage
- 1000 cm/ms stored writing speed
- Long view time

See general catalog for more details.

7A26 Dual-Trace Amplifier

- 1 M inputs
- Dc to 200 MHz bandwidth
- Five operating modes

See general catalog for more details.

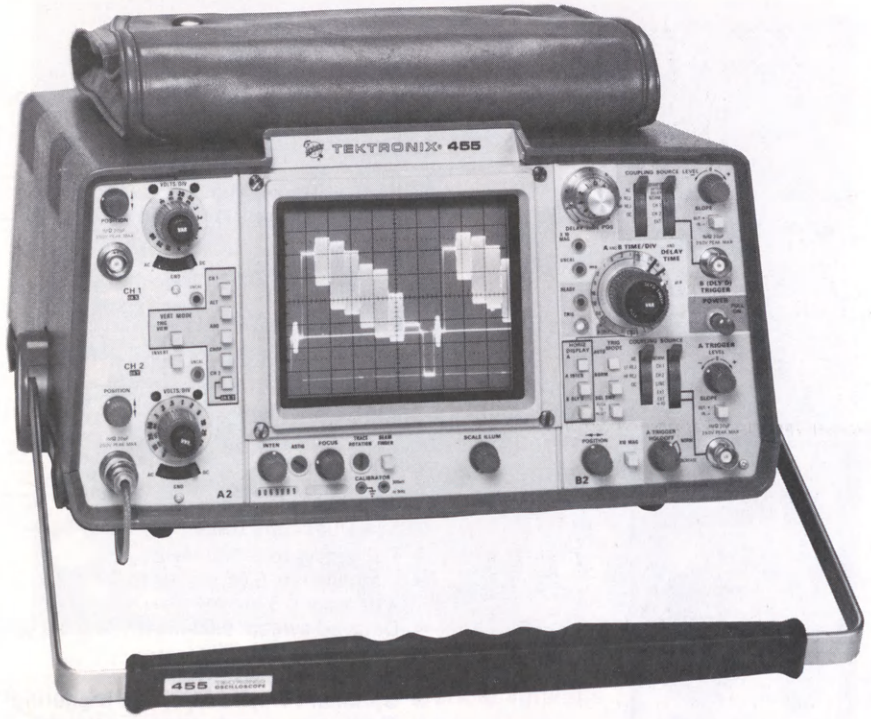
7B53A Dual Time Base

- Triggering to ® 100 MHz
- Main sweep: 0.05 ms/div to 0.5 s/div, X10 mag to 5 ns/div
- Delayed sweep: 0.05 ms/div to 0.5 s/div, X10 mag to 5 ns/div
- Calibrated mixed sweep
- Optional TV sync separator triggering
- Single sweep, auto trigger, external horizontal input

TV SYNC

Option 05, TV Sync Separator Triggering, permits stable internal line or field rate triggering from displayed composite video or composite sync waveforms. Option 05 lets you make conventional waveform displays and measurements from standard television systems with up to 1201-line, 60 Hz field rates. Individual lines may be displayed with delayed sweep features. The wide range of delayed sweeps permits accurate alternate frame, color-burst observations in the PAL color system. See general catalog for more information.

455/465B44 PORTABLE OSCILLOSCOPES



455 — 50 MHz Dual-Trace Portable Oscilloscope

455 Oscilloscope

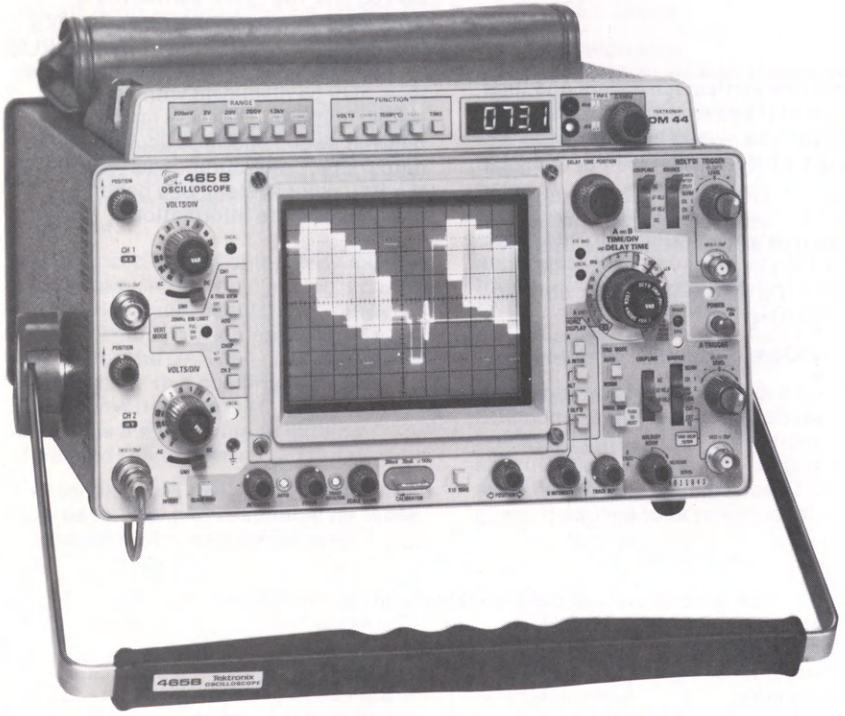
50 MHz at 5 mV/div
5 ns/div sweep rate
Trigger view
Dual-trace, delayed sweep

If you don't need a wide bandwidth oscilloscope, but want 400 Series quality, examine the 50 MHz 455. This value-leading portable combines 400 Series features, accuracy, and reliability in an inexpensive medium-bandwidth package.

The large 8x10 cm display is easy to view, and the 455's 50 MHz bandwidth at 5 mV/div is quite adequate for most applications. Graticule illumination simplifies waveform photography. Modular design means easy serviceability and calibration. Dual trace, delayed sweep, and variable-trigger holdoff capabilities are standard. The trigger signal can be viewed with the push of a button. And the 24 lb (10.9 kg) 455 accepts the 1106 Snap-On Battery Pack.

We recommend that you order your 455 with Option 05 TV Sync Separator.

See General Catalog for detailed information.



465B44 — 100 MHz Dual-Trace Portable Oscilloscope/DMM

465B44 Oscilloscope/DMM

100 MHz at 5 mV/div
2 ns/div sweep rate
Alternate sweep
Third channel trigger view
Automatic scale factor readout
Versatile trigger selection
Time, voltage, resistance, and temperature measurements

What are the most looked for features in a high-performance portable oscilloscope? Usually they include dual trace, delayed sweep, variable-trigger holdoff, a wide 100 MHz bandwidth, and a moderate price.

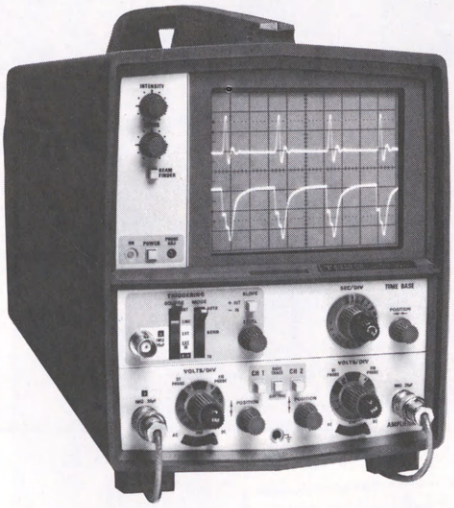
Add a large, easy-to-read 8x10 cm CRT, automatic scale factor readout, a color-coded front panel, graticule illumination, a light weight of 23 lb (10.3 kg), and 1106 Battery Pack compatibility, and you have the 465B44, the upgraded version of our popular 465. Users of portable scopes found the 465's capabilities so well suited to their needs that they made it the industry-standard portable. The 465B44 makes the best even better.

We recommend that you order the 465B44 with Option 05 TV Sync Separator.

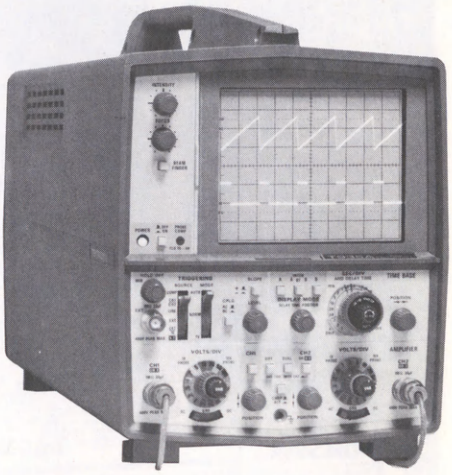
See general catalog for details.

T900 SERIES OSCILLOSCOPES

T921



T922



T935A

Easy to Use

T900 Oscilloscopes are simple to operate. Each has a large, bright (8 x 10 cm) CRT, beam finder, single knob trigger control, delay line to enable viewing of waveform leading edge, automatic selection of TV line or frame display, and functionally color-coded control panels. Convenience is further enhanced by a full complement of accessories, including 10X probes (included in price),camera, and rain jacket. T900 Oscilloscopes are also easy to handle and fit into small spaces. They weigh 15-18 lb and measure only 7 x 10 x 19in.

T921/T922
15 MHz Oscilloscopes

15 MHz at 2 mV/cm

20 ns/cm sweep rate with X10 sweep expander

Bright (12 kV) display

Easy to use

Small and lightweight

Regulated power supplies

Differential input option (T922 only)

TV line or field triggering

The T921 (single-trace) and T922 (dual-trace) Oscilloscopes provide the basic functions of a general-purpose oscilloscope at the lowest price consistent with quality construction and reliable performance.

See general catalog for detailed information.

T932A/T935A
35 MHz Oscilloscopes

35 MHz at 2 mV/cm

10 ns/cm sweep rate with X10 sweep expander

Delayed sweep (T935A)

Trigger holdoff

Bright (12 kV) CRT display

Small and lightweight

TV line or field triggering

The T932A and T935A Dual-Trace Oscilloscopes are designed for cost-sensitive applications that require greater measurement capability than the T921/T922 Oscilloscopes offer.

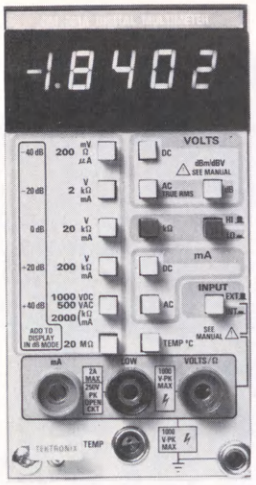
Features seldom found in moderately priced oscilloscopes include delayed sweep (T935A only) and trigger holdoff capabilities. Displayed signals that reveal insufficient detail on time-base (A) sweep may be selectively expanded using the delayed sweep feature.

For applications that require delayed sweep, the T935A is a logical choice. Except for this feature, it is identical to the T932A.

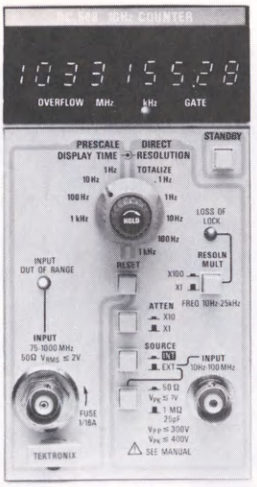
See general catalog for detailed information.

An NTSC IRE tv graticule is available. Ask your local Tek Sales Engineer or Representative.

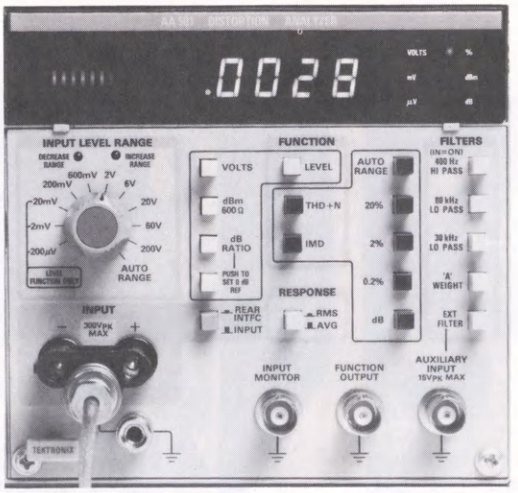
TM 500 SERIES



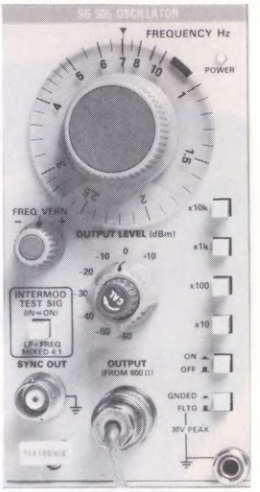
DM 501A



DC 508



AA 501



SG 505

The TM 500 Family of Test and Measurement Instruments

The word is configurabiltiy.

TM 500 is a complete family of over 40 test and measurement instruments designed to fit within six compact TM 500 Mainframes. The family includes modular counters, digital multimeters, signal sources, power supplies, signal processors, and oscilloscopes. Perfectly engineered to function individually or in combination, all instruments are interchangeable in seconds so you can slip together a system for one test, then rematch the set using other modules for a completely different application.

To complement your TM 500 System, Tektronix also offers many accessories, including a rise time limiter, a one-shot manual trigger generator, front panel circuit board adapter kits, protective covers, and external battery operated power source, cables, probes, and transducers.

DM 501A DIGITAL MULTIMETER

The DM 501A measures dc and ac voltage, dc and ac current, resistance, dB and temperature. The DM 501A gives 4½ digits of readout resolution. All with 0.05% accuracy and true RMS capability. True RMS allows accurate measurement of waveforms. DB is useful when making critical audio and communication measurements. Fast accurate temperature measurements to 240°C come from the Tektronix P6601 platinum film temperature sensing Probe. The P6601 reaches 90% of final reading in 1.5 seconds.

DC 508 FREQUENCY COUNTER

The top of our digital counter line is the DC 508, designed to operate in a TM 500 Series Power Module. The DC 508 has all of the conveniences of the DC 501, plus the ability to measure frequency from 10 Hz to 1 GHz. It also has a larger nine-digit display that shows frequency or totalized events.

With Option 01, which includes a high stability time base, you can use the DC 508 for counting aural and vision carrier frequencies and color subcarrier frequency.

AA 501 DISTORTION ANALYZER

This state-of-the-art distortion analyzer features fully automatic tuning, level setting, and nulling, a full 10 Hz to 100 kHz frequency range with a total harmonic distortion and noise of less than 0:0025% (10 Hz to 20 kHz).

By configuring the AA 501 with the SG 505 and any of over forty other TM 500 Series modular test and measurement instruments, you can possess the most advanced audio testing capability in the industry today.

TM 500 MAINFRAMES: TM 515, TM 503, TM 501

TM 500 Instruments slide into any one of several rugged power-module mainframes, available in six versions accepting one instrument or combinations up to six.

THE SG 505 AUDIO OSCILLATOR

The SG 505 Audio Oscillator features the lowest distortion level commercially available today in the 10 Hz to 110 kHz band (0.0008% between 20 Hz and 20 kHz). The SG 505 assures you of freedom from residual distortion effects, particularly critical when making audio and communication measurements. And, this extremely low distortion is coupled with many designed-in convenience features.

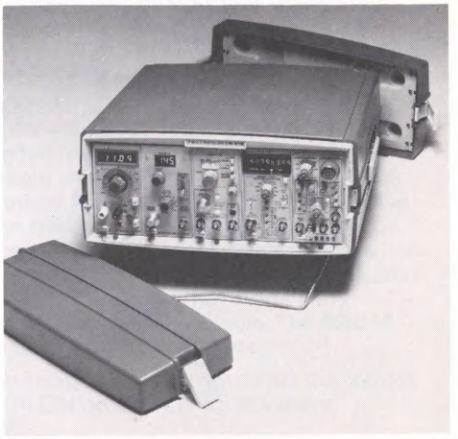
Useful features of the SG 505 include an extremely flat frequency response of ±0.1 dB between 20 Hz and 20 kHz, calibrated output level settings from +10 dBm to −60 dBm, frequency vernier control, and an optional Intermodulation Test Signal mode for SMPTE or DIN measurements of IMD.

TM 515 MAINFRAME

The ultimate in modular instrument portability is the TM 515 Traveler Mainframe, which can pack up to five separate instruments.

For on-site applications — cross-town or cross-country — you can't beat this mainframe for ruggedness.

With heavy-duty handle and tilt bail, the TM 515 looks and handles like a carry-on flight case. Front and back covers protect your instruments enroute and store accessories, then pop off to turn your "flight case" into a benchtop lab.



Especially useful for troubleshooting and designing digital TV equipment.

Logic Analyzers
Whether in design and development, service and maintenance, troubleshooting hardware, or evaluating software, logic analyzers save you time and money by enabling you to quickly sort through masses of digital information. The logic analyzer goes beyond the capabilities of your oscilloscope by decoding electronic signals into data words, displaying them in terms of combinations rather than as individual signals.

7000 SERIES LOGIC ANALYZERS

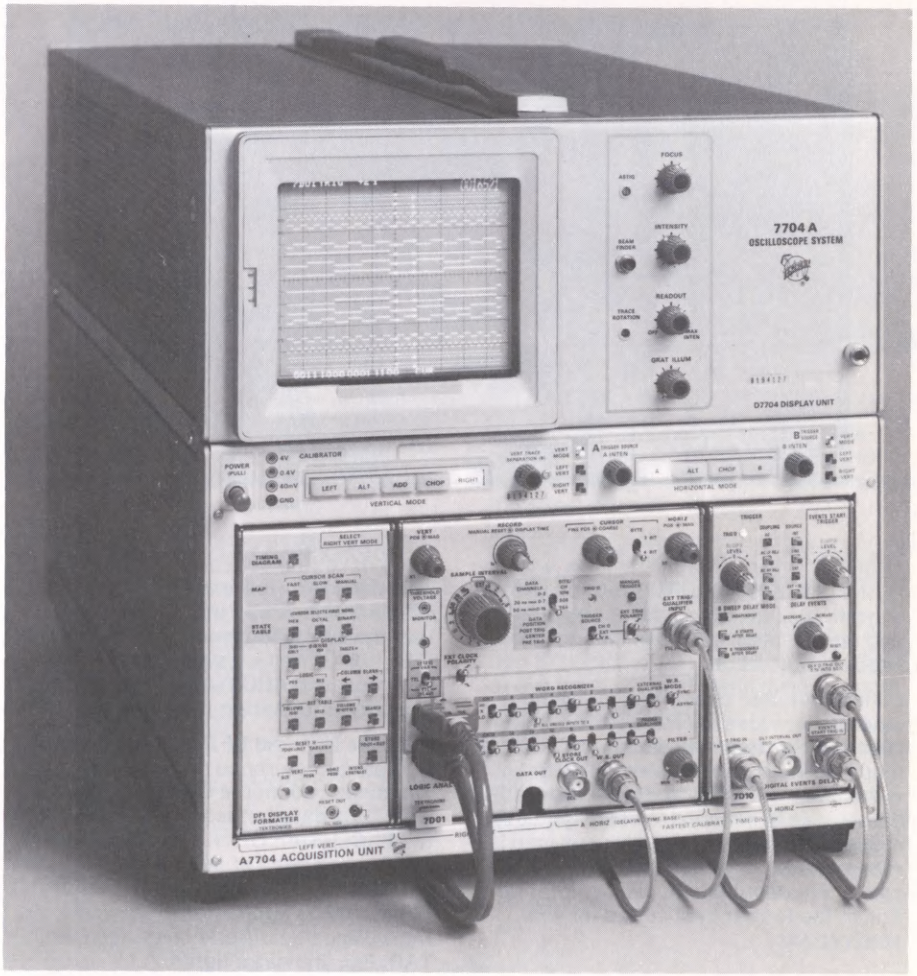
Logic analyzer systems are available within the 7000 Series of oscilloscope-based instruments from Tektronix. We offer a variety of logic analyzer configurations so you can choose as much analysis capability as you need.

Plug-in compatibility within the family enables you to convert any existing 7000 Series Oscilloscope Mainframe into a high performance logic analyzer. Or, the logic analyzer system (mainframe and logic analyzer plug-in) which you buy today can be converted later into a high performance oscilloscope or spectrum analyzer by merely adding a plug-in or two.

Match your instrument selection to your present needs and expand your system as your needs expand. In the mainframe of the 7000 Series, your investment is safe longer, and upgrading is cheaper than is would be with monolithic instruments.

7D01 LOGIC ANALYZER

The heart of the 7000 Series Logic Analyzer System is the 7D01 Logic Analyzer. This versatile, dual-wide plug-in acquires 16 channels of data simultaneously and contains its own 16 bit parallel word recognizer with two qualifiers — a probe and an external qualifier. The 7D01 also has a clock qualifier and an efficient formattable memory that stores 4096 bits in 4, 8, 16 channel formats. It captures single shot data, has a movable cursor and comes equipped with two high-Z probes. The 7D01 can be plugged into any 7000 Series Oscilloscope Mainframe, allowing your existing 7000 Series Oscilloscope to convert to a logic analyzer. Or, if you use a four-compartment mainframe, you can combine your logic analyzer with your analog oscilloscope and display the outputs of both simultaneously.



DF1 AND DF2 DISPLAY FORMATTERS

Until recently, logic analyzers have been display limited. To choose each different display format, you needed to choose a different analyzer. But Tektronix offers you a choice of formatters — the DF1 and the DF2 — designed as plug-ins for the 7D01 Logic Analyzer within the 7000 Series Mainframe.

To save money, the display formatter provides complete alphanumeric character generation so that the logic analysis package can be used in mainframes without CRT readout (mainframe Option 01).

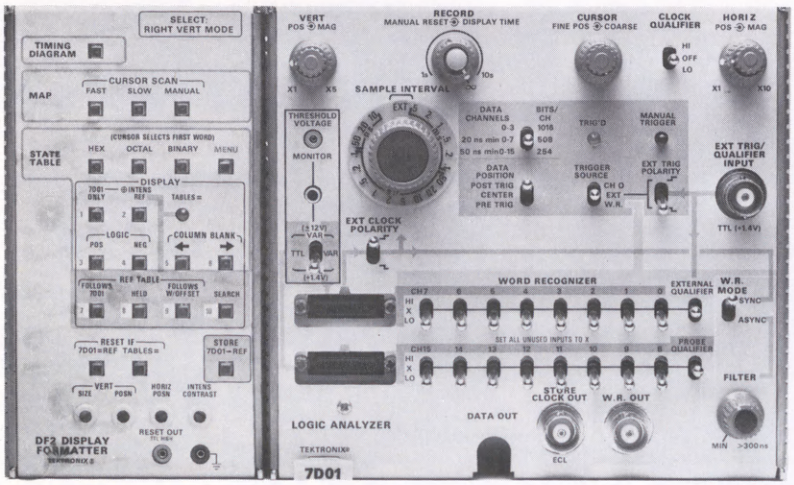
7D10/7D11 DIGITAL DELAY UNITS

The 7D10/7D11 Digital Delay Plug-ins will increase the 7000 Series system's measurement capability by adding delayed events triggering. Pulse or word timing in digital systems can now be easily verified and/or identified. In this delay-by-events mode, the 7D10/7D11 will count arbitrary trigger events, periodic or not, and deliver an output after the preselected count is reached. This count can be easily verified from 1 to 10^7 events.

The 7D10 and 7D11 identify transient locations or incorrect logic state locations in digital instruments. Using a 7D10 or 7D11 with a logic analyzer can expand the effective logic analyzer memory or delay the memory by a specific number of digital words.

The 7D10/7D11 may be used in any compartment of a 7000 Series Mainframe equipped with crt readout. If used in the vertical compartment, the delay units can trigger a time base such as 7B80 or 7B53A through the internal mainframe trigger path. When used in the A horizontal compartment, the units provide B starts after or B triggerable after delay modes.

LOGIC ANALYZERS



THE DF1 DISPLAY FORMATTER

In one package, the DF1 gives you five ways to look at logic: timing, mapping, and state table displays in binary, hexadecimal and octal.

Dislay your data on a timing or ladder diagram for close examination of timing relationships between data lines. Use the map display for an overview of digital system performance by displaying unique data words in memory. Whether you use 4, 8, or 16 channels, the Tektronix map is reconfigured for a full screen matrix. Or, select a state table and display information in the format best suited for your applications.

THE DF2 DISPLAY FORMATTER

This display formatter is identical to the DF1 in features and in function, except that the DF2 offers additional formats for IEEE 488/GPIB (General Purpose Interface Bus) and ASCII (American Standard Code for Information Interchange).

Both the DF1 and DF2 have 4K memories that permit reference data to be stored and displayed on the CRT side by side with 7D01 data for easy comparison. With the EXCLUSIVE OR + feature you can display one page of memory at a time and any differences between the two state tables will be intensified in the 7D01 table. When no differences exist, the TABLE = indicator lights.

308 DATA ANALYZER

The 308 is a 20 MHz, four-in-one portable data analyzer.

It provides Parallel Timing, Parallel State, Serial State and Signature Analysis in a convenient, easy to use package.

With the color coded keyboard, you can easily control all the functions of the 308 Data Analyzer.

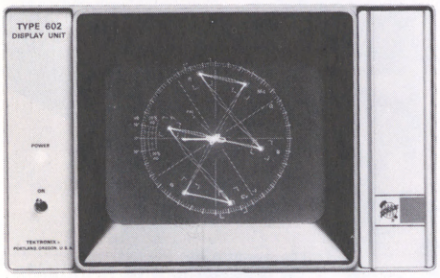
The 308's unique menu readout displays all of the status and operator mode information on its self-contained CRT. The status information is always displayed as the first line in all modes of operation. This provides you with instant identification of what you're doing before, during, and after data acquisitions.

The 308 Data Analyzer provides data acquisition via one 8 channel high impedance probe (1 MΩ, 5 pF) for Parallel Timing and Parallel State modes. For Serial and Signature acquisitions, a single channel high impedance probe (10 MΩ, 13 pF) is used. All four modes are provided with a selectable threshold (TTL or Variable + 12 V to − 12 V), to all data acquisitions from any digital logic family.

Input formats are selectable between hexidecimal, binary, octal, or decimal. For the Parallel State mode, direct display of acquisition memory is provided in hex, binary, and octal, simultaneously.

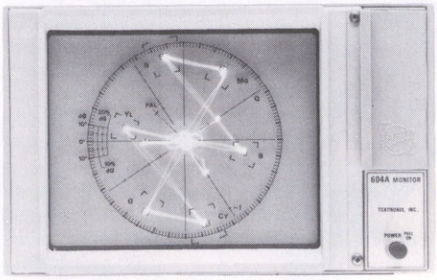
The SONY®/TEKTRONIX® 308 is manufactured and marketed in Japan by Sony/Tektronix Corporation, Tokyo, Japan. Outside of Japan the 308 is available from Tektronix, Inc., its marketing subsidiaries and distributors.

DISPLAY MONITORS



602 OPTION 05 and OPTION 08 DISPLAY MONITOR

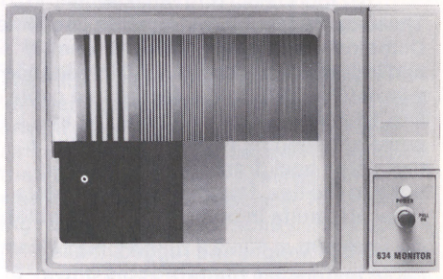
The Tektronix 602 Display Monitor's performance, features, compact size and low cost make it an excellent choice for vector display applications using Tektronix 650HR Series Color Monitors. Vector displays, a unique feature of Tektronix 650HR Series Picture Monitors, are plotted on an auxiliary display monitor such as the Tektronix 604A using the color difference signal outputs from the picture monitor.



604A OPTION 05 and OPTION 08 DISPLAY MONITOR

The Tektronix 604A is a low-cost X-Y display with a large screen viewing area and 5 MHz Z-axis bandwidth.

Vector displays, a unique feature of Tektronix 650HR Series Picture Monitors, are plotted on an auxiliary display monitor such as the Tektronix 604A using the color difference signal outputs from the picture monitor.



634 RASTER SCAN DISPLAY MONITOR

The 634 is a very high resolution, low geometric distortion monochrome video monitor, designed for applications requiring superior performance.

The 634 has a standard resolution of 1400 lines and delivers detailed imaging and optimum gray scale for photography. System manufacturers requiring less than this will want the Tektronix 634 Option 01, which offers standard resolution of 800 lines nominal while meeting most other 634 specifications.

The P45 phosphor formulation, standard on the 634, reduces the graininess of photographs taken with blue-sensitive film. The $\leq 20\%$ phosphor non-uniformity gives a more consistent gray scale over the entire display surface.

1502 AND 1503 CABLE TESTERS

These cable testing instruments use Time Domain Reflectometry (TDR) to identify and locate opens, shorts, and impedance mismatches. When connected to a cable line, the unit sends out an electric impulse and then monitors for reflections that come back from impedance variations in the line. Use these cable testers to locate faults in audio and video cables.

Small, lightweight and rugged, these cable testers will operate at least five hours on the internal, rechargeable batteries. The 1502 and 1503 have a CRT for observation. Both instruments have an optional built-in chart recorder for permanent records (available as Opt. 04).

1502

This instrument is directly calibrated in reflection coefficient (rho) and distance. The 1502 uses a step-rise pulse and provides fault resolution to 0.6 in on short cables. The 1502 performs to a maximum of 2000 ft, but with decreasing resolution as distance into the line increases.

1503

For long cables, the 1503 provides high-energy, ½-sine-shaped pulses. Range of the 1503, dependent upon cable type, is up to 50,000 ft. Resolution capability provides for resolving faults as close together as three ft on short cables. Impedance levels of 50, 75, 93, and 125 Ω are switch selectable.

Both instruments have push button calibration for distance measurements in coaxial cables having foam or solid polyethylene dielectrics, and a variable adjustment for calibrating the instruments to virtually any kind of transmission cable.

1503 OPTION 01

The 1503 Option 01 has DISTANCE CAL switches that help you locate faults conveniently in a variety of cables, including coax. If you have calibrated the 1503 Option 01 for each cable before trouble occurs, and have kept the records, you can reset the DISTANCE CAL switches exactly and begin locating damage immediately.

J16 DIGITAL PHOTOMETER/RADIOMETER

Television applications
Matching color monitors
Measuring of studio lighting

Simple to use

Completely portable

The Tektronix J16-TV is a portable digital photometer/radiometer capable of making a variety of light measurements in the television station. The J16-TV package includes the J16 Battery-operated Photometer, J6502 Irradiance Probe, light occluder, probe extension cable, and battery charger.

The J16 is an excellent transfer mechanism that provides a simple, accurate method for adjusting monitor screen color temperature. The primary colors are measured and adjusted to produce white color temperature balance.

With the optional J6503 or J6523 Probes, the J16 measures monitor screen brightness on both color and black and white monitors. Other applications include measurement of studio lighting, camera lighting, and illumination of work areas.

Nine quickly interchangeable precalibrated probes are available for measuring illuminance, irradiance, luminance, light-emitting diode output, and relative intensity. All probes use silicon photodiode sensors for maximum stability. A HOLD switch is provided with all probes to allow the reading to be stored at any time.

You can easily read the 3½ digit LED display under a wide range of ambient light conditions. Integrated circuits are used extensively to achieve stable operation, low power requirements, small size, and light weight. With normal use, internal, rechargeable nickel cadmium batteries will only need recharging weekly. A battery charger is supplied with each J16. An ac power supply, replacing the battery pack, is available for continuous operation.

J6502 IRRADIANCE PROBE

The J6502 is used to adjust monitor screen color temperatures. The probe's spectral response is flat from 450 to 950 nanometers, ±7%, enabling individual measurement of the light output for red, blue, and green screens on a color monitor. In practice, the probe is placed against the center of the monitor screen. Bias and gain controls are adjusted for each primary color to produce color temperature balance. The J6502 measures irradiance in $\mu W/cm^2$ or mW/m^2 (J6502 Opt 02).

J6511 LUMINANCE PROBE

The J6511 measures illuminance where light incident upon a surface must be measured. Applications for the J6511 include measurements of studio lighting, camera lighting, and illumination of work areas. The probe's spectral response very closely matches the CIE photopic curve (international standard for human eye response). This assures accurate measurements even when you measure spectrally different light sources. The response is also cosine corrected, giving a 180° field of view. Readout is in fc or lumens/m^2 (lux) (J6511 Opt 02).

J6503 LUMINANCE PROBE (8°)

The J6503 measures brightness on both color and black and white monitors. You can also use the probe to measure light reflected by studio scenes. In practice, the probe is pointed at the surface. The angle of view is 8°. The spectral response very closely matches the CIE photopic curve. The probe indicates luminance in fL or candelas/m^2 (nit) (J6503 Opt 02).

J6523 LUMINANCE PROBE (1°)

The J6523 is also usable for monitor luminance and studio lighting but has the advantages of being able to measure a small spot and an optical system so that the exact area being measured can be viewed through the eyepiece. The focusing range is 18 in.* to infinity. The spot measured is about 0.2 in.* in diameter at 18 in. and proportionally larger at greater distances. The spectral response matches the CIE photopic curve and the readout is in fL or candelas/m^2 (J6523 Option 02).

FOR ADDITIONAL INFORMATION

We've described on this page the probes recommended for television station applications. For more complete information on the J16 and additional probes, please request our brochure on the J16 Digital Photometer/Radiometer. We also offer application notes on picture monitor color temperature adjustments and studio lighting.

ORDERING INFORMATION

When ordering, please use the exact nomenclature given here.

J16-TV Package — for TV color monitor setup. The package includes J16 Battery-Operated Photometer, J6502 Irradiance Probe, light occluder, probe extension cable, and battery charger.

Order J16-TV for 115 V, 50/60 Hz battery charger.

Order J16-TV Option 01 for 230 V, 50/60 Hz battery charger.

For a J16-TV with metric readout, specify Option 02 in addition to above ordering information. No additional charge.

OPTIONAL PROBES

Specify probe with Option 02 for metric readout J16s (no additional charge).

Actual spectral curve of any probe is available on initial order. Specify Option 05.

J6511, Illuminance Probe, cosine corrected.

J6503, Luminance Probe (8°).

J6523, Luminance Probe (1°).

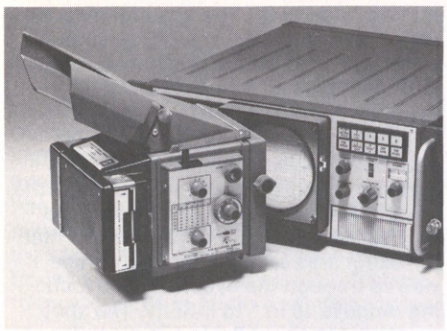
OPTIONAL ACCESSORIES

Spare Battery Pack — Order 016-0539-01

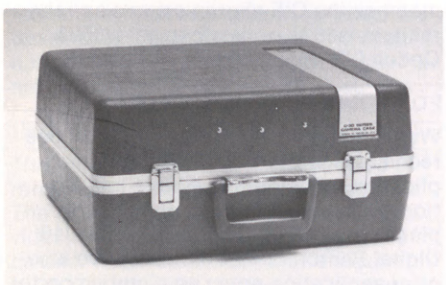
Filter Holder — mounts 1 in. diameter filters, of up to ⅜ in. thickness, to probes (except J6511, J6512, J6523); **Order 016-0527-00.**

Ac Power Supply — allows J16 to be used without batteries; **Order 119-0404-00 115 V,** 50-400 Hz; **Order 119-0404-01 230 V,** 50-400 Hz.

CAMERAS FOR OSCILLOSCOPES



520A Vectorscope with a C-59P Camera.



Optional camera carrying case.

C-59P CAMERA

The C-59P features range-finder focusing and a photometer exposure aid that lets you quickly and easily set the camera contols for sharp, correctly exposed photographs. The camera can be quickly lifted off when not needed, or swung open to provide full view of the display area. Removal of the viewing tunnel allows rackmount stacking of the camera on 7 inch vertical centers. The shutter is mechanically actuated with 6 selectable speeds from 1 to $\frac{1}{50}$ s, plus Time and Bulb. The C-59 lens has a magnification of 0.67. The aperture is continuously adjustable from f/2.8 to f/16.

Order C-59P Camera, Pack-Film Back (including 016-0249-04 Adapter).

OPTIONS

Mounting Adapter — For 520A, 521A, 522A . . **016-0295-01**

Mounting Adapter — For 1480, 1481, 1482, 1485 . . . . . **016-0342-00**

Carrying Case **016-0177-00**
Holds a complete C-50 Series Camera with extra film backs and accessories.

CAMERA SELECTION CHART

Instrument Type	C-5C	C-28	C-59P	C-30BP Option 01
520A, 521A, 522A		•	•	
528	Opt 01	•	•	•
1480, 1481, 1482, 1485		•	•	
1420, 1421, 1422	•	•	•	•
602	Opt 01	•	•	•
604A	•		•[1]	
7000 Series	Opt 01	•	•	•
465, 465B	Opt 02			•

• Indicates camera will fit instrument.
[1] The 604A does not have illuminated graticules and must be factory modified to work with this camera (special quotation required).

CAMERA/ADAPTER SELECTION CHART

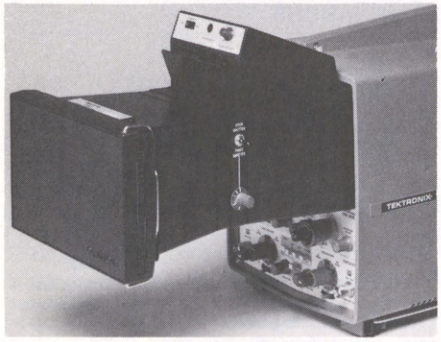
Instrument Type	C-28	C-59P	C-30BP Option 01	C-5C
520A, 521A, 522A	016-0295-01	016-0295-01		
528, 602, 1420, 1421, 1422 7000 Series	016-0249-04	**016-0249-04	016-0248-01	016-0357-01 (Opt 01 includes)
1480, 1481, 1482, 1485	016-0342-01	016-0342-00		
465, 465B			(Opt 01 includes) 016-0301-01	(Opt 02 includes) 016-0359-01

**016-0249-04 included with C-59P.

DIMENSIONS AND WEIGHTS

	C-59P		C-5C		C-28		C-30BP Option 01	
Dimensions	**in**	**cm**	**in**	**cm**	**in**	**cm**	**in**	**cm**
Height	11.5	29.2	5.5	14.0	8.06	20.5	5.1	13.0
Width	7.7	19.3	6.6	16.8	7.25	18.5	7.5	19.1
Length	10.8	27.3	10.1	25.7	9.7	24.6	10.4	26.4
Weights	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**
Net	7.0	3.2	2.9	1.3	8.5	3.8	5.0	2.3
Shipping	11.0	5.0	5.0	2.3	14.0	6.3	9.0	4.1

CAMERAS FOR OSCILLOSCOPES



C-5C Camera

Easy to Use Rotating and sliding film-backs

Fixed focus Interchangeable lenses

Lightweight

Low cost

This section describes the oscilloscope cameras recommended for use with waveform monitors and vectorscopes. You'll find additional information on scope cameras in the Tektronix General Catalog.

GRATICULE ILLUMINATION

The C-5C is a low-cost general-purpose camera with a Polaroid Pack-Film Back and pulsed graticule illumination. The C-5C attaches directly to recommended instruments without an adapter. It also mounts directly onto all 5400 Series and 7000 Series Oscilloscopes, the 602 and 604 Display Monitors, and the 577 Curve Tracer.

Graticule illumination is provided by an internal xenon flash lamp. The burst of light illuminates the phosphor, causing it to glow and back-light the dark graticule lines. The illumination is easily adjustable.

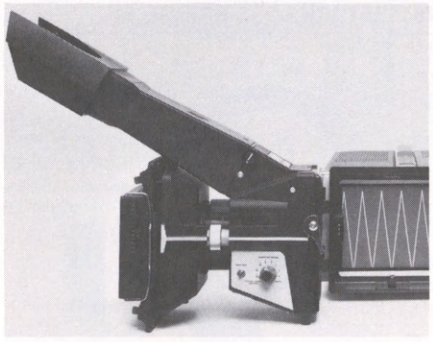
Lens — f/16 (fixed) with a magnification of 0.67 or 0.85.

Shutter — Electrically actuated with speeds of 0.1 to 5 s plus BULB operation.

Focus — Fixed. The lens has an extremely wide depth of field so adjustable focus is not needed.

Power Required — Four standard AA transistor batteries (not included) for graticule illumination. Typical life, approximately 1200 flashes or more if GRATICULE FLASH POWER switch is turned off between flashes.

Order C-5C Camera
C-5C Option 01 No graticule flash.



C-28 Camera

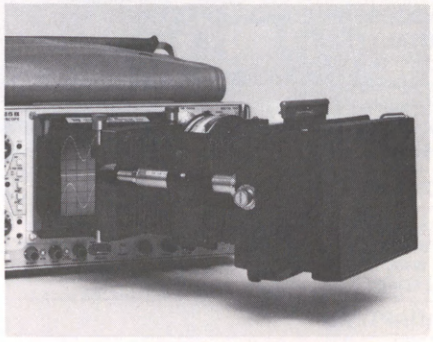
Rotating and Sliding film backs

Interchangeable lenses

Order C-28
Order C-28 for use with the 520A Series Vectorscopes. The C-28 provides 0.67 or 0.85 magnification that permits the entire graticule of the vectorscope to be photographed.

OPTIONS

Mounting Adapter — For 520A, 521A, 522A . . **016-0295-00**
Mounting Adapter — for 528, 602, 1420, 1421, 1422, 7000 Series **016-0249-04**
Mounting Adapter — for 1480, 1481, 1482, 1485 . . . . . **016-0342-00**
Carrying Case — Holds one C-28 Camera **016-0208-01**



C-30B Option 01 Camera
with a 465B Option 05 Oscilloscope

The C-30B Option 01 is a compact, lightweight camera recommended for the 465B Option 05 Television Oscilloscope. The camera includes an Adapter Frame/Corrector Lens that increases the camera's field of view so the full 8 x 10 cm CRT display area of the 465B Oscilloscope can be photographed.

The f/1.9 lens has magnification variable from 0.7 to 1.5, and a mechanically actuated shutter with 7 selectable speeds from 1 to $\frac{1}{60}$ second plus TIME and BULB. The camera also features a lift-off mounting and swingaway hinging.

Order C-30BP Option 01 Camera, Pack-Film Back.

OPTIONS

Mounting Adapter — for 528, 602, 1420, 1421, 7000 Series **016-0248-01**
Mounting Adapter — for 465B ***016-0301-01**
Carrying Case **016-0587-00**
Holds any C-30 Series Camera with room for additional film-back, additional adapter or film.

*(Adapter 016-0301-01 included as standard. Accessory with C-308P.)

ACCESSORIES

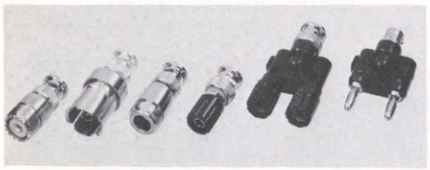
ACCESSORIES FOR SPECTRUM ANALYZERS

75 Ω feedthrough termination 011-0055-00
10X attenuator 011-0061-00
50 Ω to 75 Ω min loss attenuator 011-0057-00
75 Ω to 50 Ω min loss attenuator, ac coupled .. 011-0112-00

CHARACTERISTICS

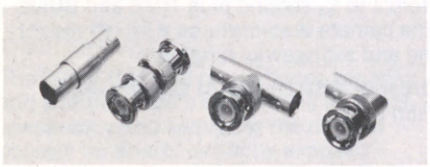
Accuracy of indicated attenuation ratio is ±2% at dc. Power rating of attenuators is ½ watt and terminations 1 watt. Voltage standing wave ratio (VSWR) not specified.

ADAPTERS



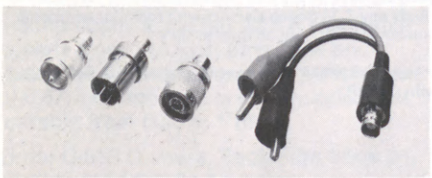
BNC — FROM LEFT TO RIGHT

Male to UHF Female 103-0032-00
Male to GR 017-0064-00
Male to N Female 103-0058-00
Male to Binding Post 103-0033-00
Male to Dual Binding Post 103-0035-00
Female to Dual Banana 103-0090-00



BNC — FROM LEFT TO RIGHT

Female to BNC Female 103-0028-00
Male to BNC Male 103-0029-00
T 103-0030-00
Elbow Male to Female 103-0031-00



BNC — FROM LEFT TO RIGHT

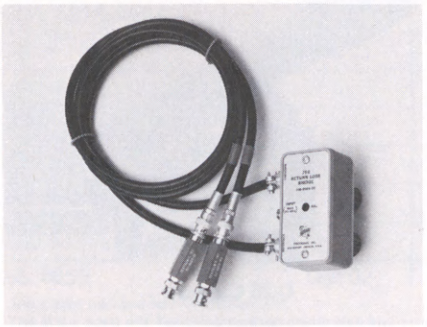
Female to UHF Male 103-0015-00
Female to GR 017-0063-00
Female to N. Male 103-0045-00
Female to clip leads 013-0076-00

BNC CABLES

Coaxial

50 Ω, 18 in. 012-0076-00
50 Ω, 42 in. 012-0057-01
75 Ω, RG 59, 42 in. 012-0074-00
93 Ω, 42 in. 012-0075-00
75 Ω, 300 in. (25 ft) 012-0157-00
75 Ω, Belden 8281, (6 ft.) 012-0159-01
75 Ω, Belden 8281, (42 in.) 012-0159-00

75 Ω RETURN LOSS BRIDGE



This Return Loss Bridge is compact and rugged. It features passive components and simple construction. It is designed to measure impedance errors in a 75 Ω system in terms of return loss, using a wide-band, high-gain differential amplifier and oscilloscope (Tektronix 1A5/547 or 7A13/7000 Series) as the error detector. The Tektronix 011-0103-00 and 011-0103-01 are 75 Ω, 0.2% double-ended termination resistors supplied as removable bridge arms. Two matched coax cables extend the bridge arms and are permanently attached to the bridge. Either or both bridge arms can be disconnected for maximum flexibility, during calibration and in making measurements.

The bridge can be driven by a number of different sources such as TV test signals, square waves, sinewaves, sin² pulses, multiburst, and swept frequency sine waves. With the Return Loss Bridge coupled to the differential amplifier and oscilloscope, a television test signal such as the multi-burst can be used to measure impedance errors over the complete video spectrum with a single measurement.

CHARACTERISTICS

Return Loss — ≥ 54 dB, dc to 10 MHz.

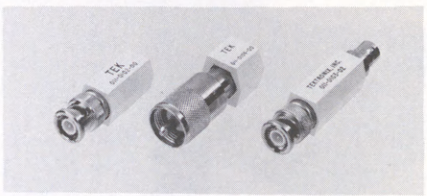
Max Input Voltage — 6 V RMS (6 V RMS, dc to 1.2 MHz decreasing to 0.7 V RMS at 10 MHz when used with Type 1A5 or 7A13.)

Return Loss Bridge, order ..... 015-0149-00.

NOISE MEASUREMENT FILTERS

147A NTSC Generator ..... see page 45
148 PAL Generator ..... see page 50
148-M Generator ..... see page 54
75 Ω Voltage Step-up Terminations ..... see page 12
Single Sideband Chroma Amplitude Corrector ..... see page 12

TERMINATIONS



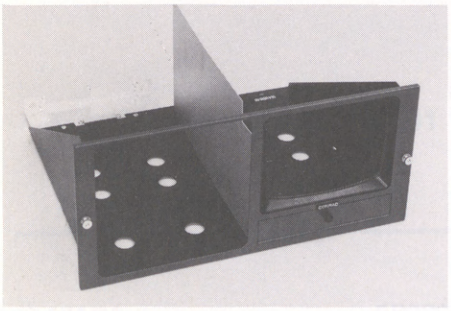
75 Ω termination. 75 Ω within 0.2% (at dc). Return loss is ≥ 52 dB, dc to 10 MHz, max input voltage is 5 V RMS, center conductor to ground.

BNC, order 011-0102-00 (left in photo).

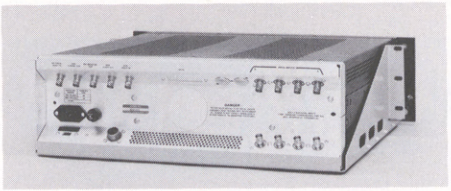
75 Ω feed through termination. 75 Ω within 0.2% (at dc). Return loss is ≥ 52 dB, dc to 10 MHz, max input voltage is 3 V RMS, center conductor to ground

BNC, order 011-0103-02 (right in photo).

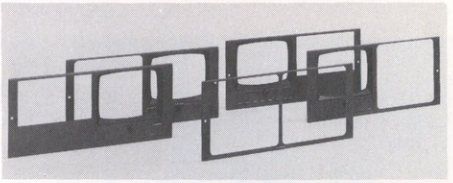
ACCESSORIES



Cradle assembly 014-0020-00 with optional bezel 014-0023-00 for mounting a 1480C Series Waveform Monitor alongside a 9 in Conrac picture monitor.



Cradle assembly 426-0309-00 is used to mount a 1480R Series Waveform Monitor in a WECO backless rack.



Optional bezels for use with cradle assembly 014-0020-00 include 014-0038-00, 014-0023-00, 014-0022-00, 014-0037-00, and 014-0024-00.

FOR USE WITH 520A SERIES

Cradle Assembly — for mounting the 520A, 521A, or 522A in a WECO backless rack, order **426-0667-00**

FOR USE WITH 528 WAVEFORM MONITORS

Rack Adapter for side-by-side mounting of 528 Option 01s, order **016-0115-02**

Panel Assembly — For covering ½ of rack adapter when only one 528 is rackmounted, order **016-0116-00**

FOR MOUNTING 9 IN SNA-9 PICTURE MONITOR

(requires 8¾ in rack space)

Mounting Cradles — A cradle assembly, with associated bezel and mounting brackets, allows the 528 Waveform Monitor to be mounted alongside a 9 in Conrac Picture Monitor, in a standard 19 in rack.

Cradle Assembly* **014-0020-00**
(Order 528 or 528 Option 03 for use in this cradle. The cover supplied with the instrument is required for cradle mounting).

Bezel and brackets for mounting 528 on operator's right,order **014-0037-00**

Bezel and brackets for mounting 528 on operator's left, order **014-0038-00**

*Also order the appropriate bezel and brackets for mounting.

FOR USE WITH 602 OPTION 05

Rack Adapter — Two 602 Option 01 Option 05s may be mounted side-by-side using the 5¼ in optional rack adapter; or, a 602 Option 01 Option 05 may be mounted side-by-side with a **1420 Option 01 Series or 528 Option 01,** order **016-0115-02**

Panel Assembly — For covering ½ of rack adapter when only one 602 Option 01 Option 05 is rackmounted, order **016-0116-00**

FOR USE WITH 604A OPTION 05

5¼ in. Rack Conversion Kits.

Note: If rackmount conversion kit is to be used, be sure to order your 604A Option 05 with the Option 28 deduction of handle and feet.

Cabinet-to-rackmount Conversion Kits, equipped with slide out assembly required to rackmount:

604A Option 05 with Option 28 in a standard rack width includes securing hardware and blank front panel when only one instrument is used, order **040-0601-00**

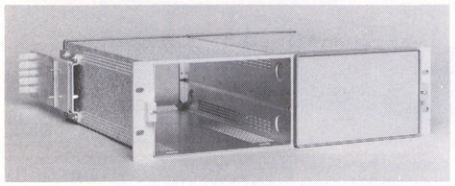
Two 604A Option 05 with Option 28 side-by-side in a standard rack width, order **040-0600-00**

604A Option 05 with Option 28 side-by-side with 528 in a standard rack width, order **016-0337-00**

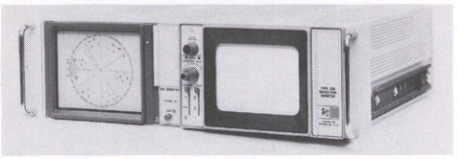
TM 503 Modular Test System and a 604A in a standard rack width, order **040-0624-00**

Rackmount-to-Cabinet Conversion Kit required to convert a rackmount 604A to a cabinet style, order **040-0602-00**

ACCESSORIES



Rack Adapter 016-0115-02 with blank panel 016-0116-00 is used for mounting a 528 Option 01 Waveform Monitor, a 602 Option 01 Display Monitor, or a 1420 Option 01 Series Vectorscope in a standard 19 in rack. Without the blank panel two instruments can be mounted side-by-side.



604A Option 05 and Option 28 side-by-side with 528 Option 01 Waveform Monitor in rackmount conversion kit 016-0337-00.

FOR USE WITH 1420 SERIES

Rack Adapter — For mounting two 1420 Option 01 Series Vectorscopes side-by-side, or mounting a 1420 Option 01 Series Vectorscope side-by-side with a 528 Option 01 Waveform Monitor, order **016-0115-02**

Panel Assembly — For covering ½ of rack adapter when only one 1420 Option 01 Series Vectorscope is rackmounted, order **016-0116-00**

FOR USE WITH 1480 SERIES

Mounting Cradles — A cradle assembly, with associated bezel, allows the 1480C Waveform Monitor to be mounted alongside a 9 in Conrac Picture Monitor in a standard 19 in rack. A cradle and bezel are also available for mounting two 1480Cs side-by-side.

FOR MOUNTING 9 IN SNA-9 PICTURE MONITOR

(Requires 8¾ in rack space)

Cradle Assembly, order **014-0020-00**

Bezel, for mounting 1480C on operator's left, order **014-0023-00**

Bezel, for mounting 1480C on operator's right, order **014-0024-00**

FOR MOUNTING TWO 1480C WAVEFORM MONITORS SIDE-BY-SIDE

(requires 8¾ in rack space)

Cradle Assembly, order **014-0020-00**

Bezel, order **014-0022-00**

1480R Cradle Assembly — For mounting the 1480R in a WECO backless rack, order **426-0309-00**

BENCH TO RACKMOUNT KITS

140 SERIES, order **040-0574-03**

520 SERIES, order **040-0491-03**

RACKMOUNT TO BENCH KITS

140, 141A, 142, 144, 145, 145M, 147A, 148, 148M, 149A, order **040-0573-00**

146, order **040-0589-00**

520 SERIES, order **040-0490-00**

CARRYING CASES (FIELD CASE)

528, order **390-0018-01**

1480C, 1481C, 1482C, 1485C, order **437-0195-00**

1420, 1421, 1422, order **390-0018-01**

PROTECTIVE VINYL COVER

For 1480 Series cabinet style with field case

1480C, 1481C, 1482C, 1485C, order **016-0085-00**

TEKTRONIX U.S. SALES & SERVICE OFFICES

Tektronix, Inc.
P.O. Box 1700, Beaverton, Oregon 97075
Telephone: (503) 644-0161 Telex: 910-467-8708 TEKTRONIX BEAV. Cable: TEKTRONIX

SALES SERVICE OFFICES

ALABAMA
Huntsville 35801
3322 S. Memorial Parkway
Suite 8
Phone: (205) 881-2912

ARIZONA
Phoenix 85040
4130 East Wood Street
Suite 100
Phone: (602) 268-8861
Tucson Area: ENterprise 383

CALIFORNIA
(Concord)
3451 Vincent Road
Pleasant Hill 94523
Phone: (415) 932-4949
(415) 932-4722
From Oakland: (415) 254-5353

17052 Jamboree Blvd.
Irvine 92714
Phone: (714) 556-8080
(213) 778-5225

(Los Angeles)
21300 Erwin Street
Woodland Hills 91367
Phone: (213) 999-1711

Los Gatos 95030
985 University Avenue
Suite 22
Phone: (408) 358-3491

San Diego 92111
7827 Convoy Court
Suite 401
Phone: (714) 292-7330

Santa Clara 95051
3200 Coronado Drive
Phone: (408) 249-5500

Santa Clara 95051
Santa Clara Annex
3333A Octavius Drive
Phone: (408) 243-9620

COLORADO
(Denver)
14 Inverness Dr. East
Suite 4A
Englewood 80112
Phone: (303) 773-1011
Telex: (Infocom) 45-4455

CONNECTICUT
Milford 06460
40 Commerce Park Road
Phone: (203) 877-1494

FLORIDA
Fort Lauderdale 33311
1871 West Oakland Park Blvd.
Phone: (305) 731-1220
Also serves Puerto Rico and
U.S. Virgin Islands
From Miami: 947-6053

Orlando 32803
3657 Maguire Blvd., Suite 100
Phone: (305) 894-3911
From the Cape Kennedy Area:
636-0343

Pensacola 32505
6425 N. Pensacola Blvd.
Phone: (904) 476-1897

GEORGIA
(Atlanta)
3320 Holcomb Bridge Road
at Peachtree Industrial Blvd.
Norcross 30092
Phone: (404) 449-4770

HAWAII
Honolulu Service Center
EMC Corporation
2979 Ualena Street
Phone: (808) 847-1138

ILLINOIS
(Chicago)
5350 Keystone Ct.
Rolling Meadows 60008
Phone: (312) 259-7580

INDIANA
Indianapolis 46219
6121 East 30th Street
Phone: (317) 545-2351

KANSAS
(Kansas City)
10580 Barkley
Suite 62
Overland Park 66212
Phone: (913) 341-3344

LOUISIANA
(New Orleans)
3004 34th St.
Metairie 70001
Phone: (504) 837-8454

MARYLAND
(Baltimore)
1526 York Road
Lutherville 21093
Phone: (301) 321-7000

Rockville 20850
2 Research Court
Phone: (301) 948-7151

MASSACHUSETTS
(Boston)
482 Bedford Street
Lexington 02173
Phone: (617) 861-6800

MICHIGAN
(Detroit)
24155 Drake Road
Farmington 48024
Phone: (313) 478-5200

MINNESOTA
St. Paul 55112
4660 Churchill Rd.
Phone: (612) 484-8571

MISSOURI
(St. Louis)
422 Anglum Rd.
Hazelwood 63042
Phone: (314) 731-4696

NEW JERSEY
Woodbridge 07095
40 Gill Lane
Phone: (201) 636-8616

NEW MEXICO
Albuquerque 87108
1258 Ortiz Drive, S.E.
Phone: (505) 265-5541
Southern N.M. Area: ENterprise 678
Southern Nevada Area: ENterprise 678

NEW YORK
Albany 12205
16 Computer Drive West
Phone: (518) 458-7291

(Long Island)
100 Crossways Park West
Woodbury, L.I. 11797
Phone: (516) 364-9060
(212) 895-9215

Poughkeepsie 12603
38 Haight Avenue
Phone: (914) 454-7540

Rochester 14623
1210 Jefferson Rd.
Phone: (716) 244-2600

(Syracuse)
1 Northern Concourse
North Syracuse 13212
Phone: (315) 455-6661
From New York: (800) 962-1095

NORTH CAROLINA
Raleigh 27612
3725 National Dr.
Suite 104
Phone: (919) 782-5624

OHIO
(Cleveland)
7830 Freeway Circle
Middleburg Heights 44130
Phone: (216) 243-8500

Dayton 45449
501 Progress Rd.
Phone: (513) 859-3681

OKLAHOMA
Oklahoma City 73105
800 N.E. 63rd
Suite 201
Phone: (405) 848-3361

OREGON
(Portland)
7000 S.W. Hampton St.
Suite 121
Tigard 97223
Phone: (503) 620-9100

Factory Service Center
Tektronix Industrial Park
Beaverton 97075
Phone: (503) 644-0161
Telex: 910-467-8708

PENNSYLVANIA
(Philadelphia)
1720 Walton Road
Blue Bell 19422
Phone: (215) 825-6400
From Harrisburg, Lancaster, and
York Area: ENterprise 1-0631

Pittsburgh 15221
1051 Brinton Rd.
Suite 300
Phone: (412) 244-9800

TENNESSEE
Knoxville 37919
9041 Executive Park Dr.
Suite 616
Phone: (615) 690-6422

TEXAS
Dallas 75234
P.O. Box 344529
Phone: (214) 233-7791

Houston 77099
10887 S. Wilcrest Drive
Phone: (713) 933-3000

San Antonio 78226
3311 Roselawn
Phone: (512) 434-4334

UTAH
Salt Lake City 84115
Timesquare Park 300 Mercer Way
Phone: (801) 486-1091

VIRGINIA
Newport News 23602
606 Denbigh Blvd.
Suite 703
Phone: (804) 874-0099

WASHINGTON
(Seattle)
19026 72nd Ave. S.
Kent 98031
Phone: (206) 575-0180

TEKTRONIX WORLDWIDE SALES & SERVICE OFFICES

ASIA, AUSTRALIA, CENTRAL & SOUTH AMERICA, JAPAN

ARGENTINA
Coasin S.A.
Virrey del Pino 4071
Buenos Aires
Phone: 52-3185, 51-9363
Telex: 012-2284
Cable: COASIN, Buenos Aires

25 de Mayo Nº 1930
Cordoba
Phone: 51-3037

AUSTRALIA
Tektronix Australia Pty. Limited
80 Waterloo Road
North Ryde, N.S.W. 2113
Sydney
Phone: 888-7066
Telex: AA24269
Cable: TEKTRONIX Australia

128 Gilles Street
Adelaide, South Australia 5000
Phone: 223-2811

Canberra Office
7 Dundas Court
Townsend Street
Phillip 2606
Canberra
Australian (Capital) Territories
Phone: 82-3587

CNR. Russell and Council Sts.,
Hawthorn East, Vic. 3123
Melbourne
Phone: 818-0594

66 Wellington Street
East Perth, W.A. 6000
Perth
Phone: 325-4198
Cable: TEKTRONIX

Brisbane Office
737 Logan Road
Greenslopes 4120
Queensland
Phone: 394-1560

BOLIVIA
Coasin Bolivia S.R.L.
Avenida 6 de Agosto 2300
La Paz, Bolivia
Phone: 40962
Telex: 5255
Cable: COALAP
Mailing Address: Casilla 7295

BRAZIL
Tektronix Industria e Comercio Ltda.
Rua Franz Schubert 59
CEP 01454 **Sao Paulo**
Phone: 813-3011
Telex: (011) 21440

Rua Barao de Lucena, 32
CEP 20000 **Rio de Janeiro**
Phone: 266-5364, 286-6946

CHILE
Equipos Industriales S.A.C.I.
Moneda 812 — Of. 912
(Casilla 13550)
Santiago
Phone: 716-882, 382-942
Telex: 3520241 FLOBRA
Cable: FLOBRA, Santiago

CHINA, PEOPLES REPUBLIC OF
Tektronix Export Marketing
P.O. Box 500
Beaverton, Oregon 97077
USA
Phone: (503) 644-0161
Telex: 910 467-8708
Cable: Tektronix

COLOMBIA
Selectronica Ltda.
Apartado Aereo 25124
Bogota, D.E.
Phone: 632874. 422376

COSTA RICA
Electro-Impex, S.A.
Apartado 620
San Jose, Costa Rica
Phone: 21-59-54
Telex: 2645 ELEPEX CR
Cable: ELECTROIMPEX

ECUADOR
Proteco Coasin Cia Ltda.
Ave. 6 de Deciembre 865 y Roca
(P.O. Box 228A)
Quito
Phone: 52-6759, 52-9684
Telex: 2865 PROTECO-ED
Cable: PROTECO, Quito

EL SALVADOR
Electronica Cuscatleca, S.A. de C.V.
21 Av. Nte. y Calle Arce 1268
Segunda Planta
San Salvador
Phone: 22-0297
Telex: 20346
Cable: COP SAL

HONG KONG
Gilman & Co. Ltd. Electrical/Electronic Dept.
280 Gloucester Road
World Trade Centre. 24/F.
Causeway Bay
(G.P.O. Box 56)
Phone: 5-794266
Telex: 83667 GILMN HX
Cable: GILMAN, Hong Kong

INDIA
Hinditron Services Private Ltd.
69-A, L. Jagmohandas Marg.
Bombay-400 006
Phone: 81 13 16/81 53 44
Telex: 953-011 2326
Cable: HSPL IN

412 Raj Mahal Vilas Extension
Bangalore-560 006
Phone: 33139
Telex: 953-043-741
Cable: TEKHIND, Bangalore

INDONESIA
P.T. Dwi Tunggal Jaya Sakti
Jakarta
Sangga Buana Bldg., 1st Floor
JL Senen Raya 44, P.O. Box 4435
Phone: 367390-9, 356801-5, 358801-5
Telex: 46624 SABUANA IA
46625 SABUANA IA
Cable: DWITUJATI

JAPAN
Sony/Tektronix Corporation
9-31, Kitashinagawa - 5,
Shinagawa-Ku
Tokyo 141
(P.O. Box 14, Haneda Airport, Tokyo 149)
Phone: 448-4851 (Area 03/Tokyo)
Telex: 02422850
Cable: SONYTEK Tokyo

c/o Taiso-Ebisu Building 1-6-11
Ebisuminami Shibuya-ku
Tokyo 150
Phone: 710-8141 (area 03/Tokyo)

c/o Takahashi Building North No. 2
2-19 Isemachi Kita-ku
Osaka-shi 530
Phone: 312-2751 (area 06/Osaka)

8 Hijie-cho 2 Nakamura-ku
Nagoya
Phone: 581-3548 (area 052/Nagoya)

KOREA
M-C International (Korea) Ltd.
22-2 Hakdong, Kangnam-Ku
Seoul
Phone: (56) 6131 thru 6138
Telex: K24228
Cable: EMCEE

MALAYSIA
Mecomb Malaysia Sdn. Bhd.
No. 2, Lorong 13/6A
(P.O. Box 24)
Petaling Jaya, Selangor
Phone: 773455
Telex: 37605
Cable: MECOMB Petaling Jaya

MEXICO
Tecnicos Argostal, S.A.
Depto. Control de Calidad
Av. Jalisco 180
(Apdo. Postal M-2511,
Mexico 1, D.F.)
Mexico 18, D.F.
Phone: 515-85-80
Telex: 017-74208
Cable: ARGOSTAL, Mexico

Av. Universidad 3335 Norte
Monterrey, N.L.
Phone: 51-13-60
Telex: 038865

Calz. J. Jesus Glz. Gallo 383
Guadalajara, Jal.
Phone: 17-26-46, 17-78-12
Telex: 068-2710

NEW ZEALAND
W. & K. McLean Ltd.
103-105 Felton Mathew Avenue
Glen Innes
(C.P.O. Box 3097)
Auckland 6
Phone: 587-037
Telex: NZ 2763 KOSFY
Cable: KOSFY, Auckland

5th Floor, Westbrook House
181 Willis Street
(C.P.O. Box 496)
Wellington 1
Phone: 851-450
Telex: NZ 3053 KOSFY

PAKISTAN
Pak-Land Corporation
Central Commercial Area
Iqbal Road
P.E.C.H. Society
Karachi-29
Phone: 437315, 438084
Cable: PAKLAND, Karachi

PANAMA
Executive Marketing Corp.
Apartado 4929
Panama 5
Phone: 64-9354, 64-9851
Telex: 328-2220
Cable: MARKETING PA, Panama

PERU
Importaciones y Representaciones Electronicas S.A. (IRE Ingenieros)
Avda. Franklin D. Roosevelt 105
Edificio Rimac
Lima
Phone: 28-86-50
Telex: 25663
Cable: IREING, Lima

PHILIPPINES
Philippine Electronic Industries, Inc.
3rd Floor, RCA Global Building
8755 Paseo de Roxas
(P.O. Box 498, Makati Commercial Center)
Makati, Rizal 3117
Phone: 87-99-26, 87-99-27, 87-99-28
Telex: 7222036
Cable: PHILECTRON, Manila

SINGAPORE
Mechanical & Combustion Engineering Co. Pte. Ltd.
10-12, Jalan Kilang
(P.O. Box 46,
Alexandra Post Office)
Singapore 3
Phone: 647151
Telex: RS-23178
Cable: MECOMB, Singapore

SRI LANKA
Maurice Roche Limited
G.P.O. Box 61
Colombo
Phone: 25846, 25847, 25848
Cable: LAXAPANA, Colombo

SURINAM
Wong Sang Tsoi & Co.
20-24 Dominestraat
(P.O. Box 163)
Paramaribo
Phone: 73511, 75187, 72154, 76369
Cable: SANGTSOICO, Paramaribo

TAIWAN
Heighten Trading Co. Ltd.
16 Nanking East Road, Section 3
P.O. Box 46-65
Taipei 104 ROC
Phone: 551-916
Telex: 21472
Cable: HEIGHTEN, Taipei

THAILAND
G. Simon Radio Company Ltd.
30, Patpong Avenue
Bangkok
Phone: 30991-3
Cable: SIMONCO, Bangkok

URUGUAY
Coasin Uruguaya S.R.L.
Casilla de Correo No. 1400
Correo Central
Montevideo
Phone: 91-79-78
Cable: COAUR, Montevideo

VENEZUELA
Equilab, C.A.
Torre KLM 6º Piso
Avda Romulo Gallegos
Santa Eduvigis
(Apartado 60497)
Caracas 106
Phone: 283.1166 (5 lines)
Telex: 21860 EQUIX
Cable: EQUILAB, Caracas

Areas Not Listed, Contact:
Tektronix, Inc.
Export Marketing
P.O. Box 500
Beaverton, Oregon 97077
U.S.A.
Phone: (503) 644-0161
Telex: 910-467-8708
Cable: TEKTRONIX

AFRICA, EUROPE, MIDDLE EAST

ALGERIA
SALES:
Tektronix Limited
P.O. Box 36
Guernsey, Channel Islands
MAINTENANCE:
Measurelec
144 Bd Salah Bouakouir
Algiers
Phone: 61.50.99 and 61.50.24
Telex: 53733 TEKNY DZ

ANGOLA
Tecnidata Representacoes Tecnicas e Electronica Aplicada Lda
Rua Sociedade de Geografia 21-21A
Caixa Postal 1619
Luanda
Phone: 32025-32309
Telex: 3019 TECDATA AN

AUSTRIA
Rohde & Schwarz-Tektronix Ges.m.b.H.
Sonnleithnergasse 20
A-1100 **Vienna**
Phone: Vienna 62 61 41
Telex: Vienna 13933

BELGIUM
TEKTRONIX nv/sa
Mercure Centre
Rue De La Fusee NR 100
1130 **Bruxelles**
Phone: 02/720.80.20
Telex: 26713
Cable: TEKBEL

BULGARIA
Rohde & Schwarz-Tektronix Ges.m.b.H.
Sonnleithnergasse 20, A-1100
Vienna, Austria
Phone: Vienna 62 61 41
Telex: Vienna 13933

CZECHOSLOVAKIA
Rohde & Schwarz-Tektronix Ges.m.b.H.
Sonnleithnergasse 20, A-1100
Vienna, Austria
Phone: Vienna 62 61 41
Telex: Vienna 13933

DENMARK
Tektronix A/S
Herlev Hovedgade 119
Post Box 575
DK-2730 **Herlev**
Phone: (02) 84 56 22
Telex: 35239 Tekas dk

EAST AFRICA (Kenya, Tanzania and Uganda)
Engineering & Sales Co., Ltd.
Bankhouse, Government Road
(P.O. Box 46658)
Nairobi, Kenya
Phone: 26815
Cable: ENGSALES Nairobi

EGYPT
Giza Systems Engineering Company
P.O. Box 1913
4 E1-Hesn Street
Giza
Cairo
Phone: 841200, 849399, & 849200
Telex: 92096 EKA UN

FEDERAL REPUBLIC OF GERMANY
Rohde & Schwarz Handels Ges.m.b.H.
Ernst-Reuter-Platz 10
1000 **Berlin-West** 10
Phone: (030) 3 41 40 36
Telex: 0 181 636
Cable: ROHDESCHWARZ Berlin

Rohde & Schwarz Vertriebs Ges.m.b.H.
Grosse Bergstrasse 213
2000 **Hamburg** 50
Phone: (040) 38 01 91
Telex: 213 749
Cable:
ROHDESCHWARZ Hamburg

Herzogstrasse 61
6078 Neu-Isenburg
Phone: (06102) 3136
Telex: 04185641

Kriegsstrasse 39
7500 **Karlsruhe** 1
Phone: (0721) 2 79 81
Telex: 7 826 730
Cable:
ROHDESCHWARZ Karlsruhe

Sedanstrasse 13-17
5000 **Koln** 1
Phone: (0221) 77 22-1
Telex: 888-5417
Cable: ROHDESCHWARZ Koln

Tassiloplatz 7
8000 **Munchen** 90
Phone: (089) 41 62-1
Telex: 522953
Cable:
ROHDESCHWARZVERTRIEB

Donaustrasse 36
8500 **Nurnberg**
Phone: (0911) 6 48 81
Telex: 0626255

Technisches Buro
Plieninger Strasse 150
7000 **Stuttgart** 80
Phone: (0711) 72 20 39
Telex: 0725533

FINLAND
Tektronix O/Y
Larin Kyostin tie 4,
00650 **Helsinki** 65
Phone: 90-722 400
Telex: 12-3435 TEKOY SF

FRANCE
TEKTRONIX
Z.I. Courtaboeuf, B.P. 13
91401 **Orsay**
Phone: 907 78 27
Telex: TEKFRANS 690332
Cable: TEKFRANS Orsay

Centre Regional de Lyon
163, Boulevard des Etats-Unis
69008 **Lyon**
Phone: (78) 76.40.03
Telex: TEKLYON 300150

Centre Regional du SUD-EST
Z.I. Rue Andre Ampere
13290 **Aix-Les-Milles**
Phone: (42) 26.62.03
Telex: 440045

Centre Regional de Rennes
103A, avenue de Crimee
35000 **Rennes**
Phone: (99) 51 21 16
Telex: TEKREN 740829

Centre Regional de Strasbourg
1 Rue du Marechal Lefebvre
67100 **Strasbourg**
Phone: (88) 39.49 35
Telex: TEKSTBG 890470

Centre Regional de Toulouse
284, route Saint-Simon
31300 **Toulouse**
Phone: (61) 40 24 50
Telex: TEKTOULS 530243

TEKTRONIX WORLDWIDE SALES & SERVICE OFFICES

GREECE
Marios Dalleggio Representations
2, Alopekis Street
Athens 139
Phone: 710.669, Telex: 216435
Telex Answer Code: DALM GR
Cable: DALMAR Athens

HUNGARY
Rohde & Schwarz-Tektronix Ges.m.b.H.
Sonnleithnergasse 20, A-1100
Vienna, Austria
Phone: Vienna 62 61 41
Telex: Vienna 13933

ICELAND
Kristjan O. Skagfjord Ltd.
P.O. Box 906
Reykjavik
Phone: 24120
Telex: 2133 KOS IS

IRAN
Irantronics Company Ltd.
20 Salm Road
Roosevelt Avenue
Tehran
Phone: 828294, 831564, 836466, 834459
Telex: 212956 BERK IR
Cable: BERKEHKAR, Tehran

IRAQ
Al Manar Engineering WLL
Al-Namman Building
Jumhuria Street
(P.O. Box 86)
Baghdad
Phone: 60992 or 8880333
Telex: 2244 PUBIK
Cable: MECHSULT

ISRAEL
Eastronics Ltd.
11 Rozanis Street
Tel-Baruch
(P.O. Box 39300)
Tel Aviv
Phone: 475151
Telex: 033-638
Cable: EASTRONIX Tel Aviv

ITALY
Silverstar Spa, Ltd.
Via del Gracchi No. 20
20146 **Milano**
Phone: 4996 (12 lines)
Telex: 332189 SILSTAR Milano
Cable: SILVERSTAR Milano

Via Paisiello No. 30
00198 **Roma**
Phone: 844 88 41/5 (five lines)
Telex: 610511 SILSTAR Roma
Cable: SILVERSTAR Roma

Piazza Adriano, 9
10139 **Torino**
Phone: 44.32.75/6
Telex: 220181
Cable: SILVERSTAR Torino

IVORY COAST
SITEL
Blvd. Giscard D'Estaing-Carrefour
de Marcory Zone 4A
Abidjan 01
Phone: 353600 or 353502
Telex: SITEL ABIDJAN NR 3354
Cable: RAYBACH ABIDJAN

JORDAN
TAREQ Scientific Bureau
Consult-Tel
P.O. Box 35055
Amman
Phone: 42333
Telex: 1593 CIT HTL
Cable: CONSUL TEL

KUWAIT
TAREQ Company
P.O. Box Safat 20506
Phone: 436100 & 436045
Telex: 2315 ZUAITER KT
Cable: ZUAITER KUWAIT

LEBANON
Projects S.A.L.
(P.O. Box 11-5281)
Beirut
Phone: 331680
Telex: 20466LE
Cable: PROJECTS Beirut

MOROCCO
SCRM
29 BD Girardot
Casablanca
Phone: 27 69 11
Telex: 21815
Cable: SCRM CASA (21815)

THE NETHERLANDS
Tektronix Holland N.V.
Meidoornweg 2
"Postbus 164"
Badhoevedorp
Phone: 02968-1456
Telex: 18490

NORWAY
Tektronix Norge A/S
Lorenfaret 1,
Okern
Oslo 5
Phone: 02-212855
Telex: 56-17690 TEK N

POLAND
Rohde & Schwarz-Tektronix Ges.m.b.H.
Sonnleithnergasse 20, A-1100
Vienna, Austria
Phone: Vienna 62 61 41
Telex: Vienna 13933

PORTUGAL
Equipamentos de Laboratorio Lda.
Estrada Lisboa - Sintra Amadora
P.O. Box 1100 (Casal de Garoto)
Lisbon
Phone: 97 65 51
Telex: 12702 EQUILAB
Cable: EQUILAB, Lisboa

REPUBLIC OF SOUTH AFRICA
Protea Physical & Nuclear Instrumentation (Pty.) Ltd.
P.O. Box 39127
Bramley 2018
746 Sixth Street
Wynberg, Standton
Transvaal
Phone: (27 11) 786-3647
Telex: 8-4689

P.O. Box 141
Paardeneiland 7420
30 Auckland Street
Paardeneiland
(Cape Town Branch)
Phone: 51-3247
Telex: 5-77551

P.O. Box 47031
Greyville 4025
116 Stamford Hill Road
Durban
Phone: 39-1100
Telex: 6-2775

ROMANIA
Rohde & Schwarz-Tektronix Ges.m.b.H.
Sonnleithnergasse 20, A-1100
Vienna, Austria
Phone: Vienna 62 61 41
Telex: Vienna 13933

SAUDI ARABIA
Electronic Equipment Mktg. Ltd.
P.O. Box 3750
Riyadh
Phone: 32700, 37023
Telex: 201120 Zuhair SJ

SPAIN
Tektronix Espanola S.A.
c/Condesa de Venadito 1-5 Izq
Madrid 27
Phone: (91) 404-1011
Telex: 46014 TMK E

Gran Via Carlos 111
97G
Barcelona 28
Phone: (93) 330-2008

SUDAN
Cine & Photo Supply Company (CPSC)
P.O. Box 393
Khartoum
Phone: 75162, 76943 and 42478
Telex: 304 Photokina
Cable: PHOTOKINA

SWEDEN
Tektronix AB
Fack
S-171 04 **Solna**
Phone: 08/83 00 80
Telex: 17831 Tekswed S
Cable: TEKTROSWED Stockholm

Kommendorsgatan 6
S-414 59 **Gothenburg**
Phone: 031/42 70 35

SWITZERLAND
Tektronix International A.G.
(P.O. Box 57)
CH-6301 **Zug**
Phone: 042 21 91.92
Telex: 78808
Cable: TEKINTAG

SYRIA
General Trading Co.
P.O. Box 798
Damascus
Phone: 114807, 224170, 559108
Telex: 11283 GITCO SY

TURKEY
Erkman Elektronik Aletler
Ticaret Anonim Sirketi
Necatibey Caddesi 92/3
Karakoy, **Istanbul**
Phone: 44 15 46/44 76 51
Telex: 23353 MSE TR
Cable: INGMESUER, Istanbul

TUNISIA
EL ESLEK
Societe Industrielle et Commerciale d' Equipements Electriques et Electroniques
3 Rue de Vesoul
Tunis
Phone: 244372
Telex: 13664 ESLEK TN

UNITED KINGDOM
Tektronix U.K. Limited
Beaverton House
36-38, Coldharbour Lane
(P.O. Box 69)
Harpenden, Herts
Phone: Harpenden 63141, 61251
Telex: 25559
Cable: TEKTRONIX Harpenden

181A, Mauldeth Road
Burnage
Manchester 19
Phone: 061-224-0446
Telex: 668409

Pentland House,
Almondvale South **Livingston,**
West Lothian, EH54 6NG
Phone: Livingston 32766

USSR
Rohde & Schwarz Tektronix Ges.m.b.H.
Sonnleithnergasse 20, A-1100
Vienna, Austria
Phone: Vienna 62 61 41
Telex: Vienna 13933

YUGOSLAVIA
Rohde & Schwarz Tektronix Ges.m.b.H.
Sonnleithnergasse 20, A-1100
Vienna, Austria
Phone: Vienna 62 61 41
Telex: Vienna 13933

ZAMBIA
Baird and Tatlock (Zambia) Ltd.
Chandwe Musonda Road
(P.O. Box 1038)
Lusaka
Phone: 75315/6
Telex: 4277
Cable: PIPETTE, Lusaka

Brunell Road
(P.O. Box 1097)
Ndola
Phone: 3522 & 2253/4/6
Telex: 3441
Cable: PIPETTE, Ndola

Eastern European Countries Not Listed, Contact:
Rohde & Schwarz-Tektronix Ges.m.b.H.
Sonnleithnergasse 20, A-1100
Vienna, Austria
Phone: Vienna 62 61 41
Telex: Vienna 13933

Other Areas Not Listed, Contact:
Tektronix Limited
P.O. Box 36
St. Peter Port
Guernsey, Channel Islands
Phone: Guernsey 35781
Telex: 41193
Cable: TEKTRONIX GUERNSEY

CANADA

CANADA
Tektronix Canada Ltd.
P.O. Box 6500
Barrie, Ontario
L4M4V3
Phone: (705) 737-2700
Telex: 06-875672
Cable: TEKANADA

(Montreal)
900 Selkirk Street
Pointe Claire, Quebec
H9R 3S3
Phone: (514) 697-5340
Telex: 05-821570
Cable: TEKANADA

Suite 106
3016, 19th St. N.E.
Calgary, Alberta
T2E 4Y3
Phone: (403) 269-3138
Telex: 038-21730

6025 103 A Street
Edmonton, Alberta
T6H 2J7
Phone: (403) 434-9466
Telex: 037-2795

1792 Courtwood Crescent
Ottawa, Ontario
K2C 2B5
Phone: (613) 225-2850
Telex: 053-4119

(Vancouver)
4519 Canada Way
Burnaby, B.C.
V5G 1K1
Phone: (604) 438-4321
Telex: 043-54602

Unit 68, Border Place
1313 Border St.
Winnipeg, Manitoba
R3H OX 4
Phone: (204) 632-4447, 632-4448
Telex: 07-55564

(Halifax)
Burnside Commercial Centre
10 Akerley Blvd.
Dartmouth, Nova Scotia
B3B 1J4
Phone: (902) 469-9476
Telex: 019-31534

Canadian Areas Not Listed, Contact:
Tektronix Canada Limited
P.O. Box 6500
Barrie, Ontario
L4M 4V3
Phone: (705) 737-2700
Telex: 06-875672
Cable: TEKANADA

TEKTRONIX WORLDWIDE MARKETING CENTERS

U.S.A.
Tektronix, Inc.
U.S. Marketing
P.O. Box 1700
Beaverton, Oregon 97075
Phone: (503) 644-0161
Telex: 910-467-8708
Cable: TEKTRONIX

AFRICA, EUROPE, MIDDLE EAST
Tektronix International, Inc. European Marketing Centre
Postbox 827
1180 AV **Amstelveen**
The Netherlands
Telex: 18312

AMERICAS/PACIFIC (Asia, Australia, Central & South America, Japan)
Tektronix, Inc.
Export Marketing
P.O. Box 500
Beaverton, Oregon 97077
Phone: (503) 644-0161
Telex: 910-467-8708
Cable: TEKTRONIX

GENERAL TERMS OF SALE AND WARRANTY

Orders should be placed with your Tektronix Field Engineering Office.

Tektronix, Inc., offers many different terms of sale in order to meet varied purchasing objectives and to assist in financial planning. Any of the following terms may be arranged with a Tektronix Field Engineer.

NET 30 DAYS

Tektronix, Inc., standard terms of sale are Net 30 days following the date of shipment. As with all credit terms, satisfactory credit accommodations must be arranged.

EXTENDED TERMS OF SALE

Extended terms of 60 to 180 days are available on the same single payment basis as standard terms. Since the cost of extended terms is not included in catalog prices, a service charge is added to the invoice. The amount of the service charge depends upon the number of days the terms are extended.

SECURITY AGREEMENT

This program provides monthly installment payment terms while Tektronix products are in use. Accessories and parts are not available unless they are associated with the products being purchased. New and used products may be purchased with a deduction for applicable quantity discounts.

An advance payment equal to approximately 10% of the purchase price of the equipment desired is required for a Security Agreement. Installment terms covering the balance of the contract price are available for 6, 12, 18, 24, 30, or 36 months. Minimum balance amounts may be financed, ranging from $200 for six months to $2000 for thirty-six months. Longer terms of 48 to 60 months are available by quotation for financed balances of more than $10,000. There are no maximum finance balances.

All products carry the standard Tektronix, Inc., warranty. The customer is responsible for the equipment and applicable property taxes, licenses, etc. Upon completion of the term of agreement and prescibed payments, the customer owns the equipment.

LEASE AGREEMENT

A standard lease term of 6, 12, 18, 24, 30, and 36 months is offered. Longer terms are negotiable. Under a Lease Agreement, the customer pays for the use of the product for the term of agreement. It is not a month-to-month rental. . . it is a non-cancellable, fixed-term lease requiring no advance payment. At the expiration of the lease there is the opportunity to update the instruments, to renew the existing lease, or to return the equipment at the expense of Tektronix, Inc. The customer may exercise an option to purchase the equipment at any time during the term of the lease, provided he gives thirty days written notice. A portion of the installments will be credited toward the purchase price.

The standard Tektronix, Inc., warranty and quantity discount apply to products leased under this installment term.

WARRANTY

Tektronix intends to provide to its customers excellent value in its products, services and business practices. Tektronix warrants that the products which it manufactures and sells are free from defects in materials and workmanship. Tektronix will repair or replace, at its option, those products which Tektronix determines to be defective within the period specified in the warranty statement accompanying each product.

SHIPMENT

All prices, quotations, and shipments are FOB Beaverton, Oregon, unless otherwise specified.

Unless otherwise specified, shipment will be made via most economical method. Surface and air shipments will be insured at full valuation unless your order instructs otherwise.

Specification and price change privileges reserved.

Copyright © 1980 Tektronix, Inc. All rights reserved. Printed in U.S.A. Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specification and price change privileges reserved. TEKTRONIX, TEK, SCOPE-MOBILE, TELEQUIPMENT, and ® are registered trademarks. For further information, contact: Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077. Phone: (503) 644-0161; TWX 910-467-8708; Cable: TEKTRONIX. Subsidiaries and distributors worldwide.

INDEX

Products Grouped by Family and Number

	Page
ACCESSORIES	90
ANALYZERS/CORRECTORS	
1440 NTSC Automatic Video Corrector	72
1460 PAL Automatic Video Corrector	72
1980 ANSWER Automatic Video Measurement Set	67
DIGITAL CONVERTERS	
ADC 820 A-D Converter	77
DAC 850 D-A Converter	78
GENERAL PURPOSE PRODUCTS FOR TELEVISION	
Cameras for Oscilloscopes	
C-5C Camera	89
C-28 Camera	89
C-30BP Camera	89
C-59P Camera	88
Display Monitors	
602 Display Monitor	85
604A Display Monitor	85
634 Raster Scan Display Monitor	85
J16-TV Digital Photometer/Radiometer	87
J6502 Irradiance Probe	87
J6503 Luminance Probe	87
J6511 Illuminance Probe	87
J6523 Luminance Probe	87
Logic Analyzers	
308 Data Analyzer	84
7D01 Logic Analyzer	83
DF1 Display Formatter	83, 84
DF2 Display Formatter	83, 84
7D10/7D11 Logic Analyzer	83
OSCILLOSCOPES	
455 50 MHz Dual-Trace Portable Oscilloscope	80
465B44 100 MHz Dual-Trace Portable Oscilloscope/DMM	80
T921 15 MHz Single-Trace Portable Oscilloscope	81
T922 15 MHz Dual-Trace Portable Oscilloscope	81
T932A 35 MHz Dual-Trace Portable Oscilloscope	81
T935A 35 MHz Dual-Trace Portable Oscilloscope	81
7633 Multimode Storage Mainframe	79
7A18 Dual-Trace Amplifier	79
7B53A Dual Time Base	79
TM 500 TEST AND MEASUREMENT INSTRUMENTS	
DM 501A Digital Multimeter	82
AA 501 Distortion Analyzer	82
SG 505 Audio Oscillator	82
DC 508 Frequency Counter	82
TM 515 Mainframe	82
GENERATORS	
143 SECAM Signal Generator	40
145-M PAL-M Signal Generator	42
1430 Random Noise Measuring Set	58
1441 VIR Signal Deleter/Inserter	56
1461 Insertion Test Signal Generator Deleter/Inserter	56
1470 Sync and Test Signal Generator	37
1474 Sync Generator	37
147A NTSC Signal Generator	45
148 PAL Signal Generator	50
148-M PAL-M Signal Generator	54
149A NTSC Signal Generator	45
GVG 3257A Automatic Changeover	36
1410 SERIES GENERATORS	
1410 NTSC Generator Mainframe	23
SPG1 NTSC Sync Pulse Generator	24
SPG2 NTSC Sync Pulse Generator	24
SPG3 NTSC Timing Generator	24
TSG1 NTSC Color Bars Generator	25
TSG2 NTSC Convergence Generator	26
TSG3 NTSC Linearity Generator	26
TSG4 NTSC Black Burst Generator	27
TSG5 NTSC Pulse and Bar Generator	28
TSG6 NTSC Multiburst/Video Sweep Generator	29
TSP1 NTSC Switcher/Convergence Generator	30
1411 SERIES GENERATORS	
1411 PAL Generator Mainframe	23
SPG11 PAL Sync Pulse Generator	24
SPG12 PAL Sync Pulse Generator	24
SPG13 PAL Timing Generator	24
TSG11 PAL Color Bars Generator	25
TSG12 PAL Convergence Generator	26
TSG13 PAL Linearity Generator	26
TSG14 PAL Black Burst Generator	27
TSG15 PAL Pulse and Bar Generator	28
TSG16 PAL Multiburst/Video Sweep Generator	29
TSP11 PAL Switcher/Convergence Generator	30
1412 PAL-M SERIES GENERATORS	
1412 PAL-M Generator Mainframe	23
SPG22 PAL-M Sync Pulse Generator	24
TSG21 PAL-M Color Bars Generator	25
TSG23 PAL-M Linearity Generator	26
TSP21 PAL-M Switcher/Convergence Generator	30
PICTURE MONITORS	
650HR High Resolution Color Picture Monitors PAL, NTSC	14
653HR/656HR SECAM High Resolution Color Picture Monitors	17
670A Series Color Picture Monitors PAL, NTSC, NTSC + RGB	19
RADIO FREQUENCY PRODUCTS	
1405 Television Sideband Adapter	65
1405 Option 01 (625/50) Television Sideband Adapter	65
7L12 Spectrum Analyzer	65
7L13 Spectrum Analyzer	65
7613 Variable Persistence Mainframe	65
492 Spectrum Analyzer	66
7L5 Spectrum Analyzer	66
7L18 Spectrum Analyzer	66
1450-1 (SYSTEM M) TELEVISION DEMODULATOR MAINFRAME	
1450-2 (SYSTEM B/G) TELEVISION DEMODULATOR MAINFRAME	
Fixed-Channel Television Down Converters	59
Tunable Television Down Converters	59
VECTORSCOPES	
520A NTSC Vectorscope	10
521A PAL Vectorscope	10
522A PAL-M Vectorscope	10
1420 NTSC Vectorscope	13
1421 PAL Vectorscope	13
1422 PAL-M Vectorscope	13
WAVEFORM MONITORS	
528 Waveform Monitor	8
1480 NTSC Waveform Monitor	4
1481 PAL Waveform Monitor	4
1482 PAL-M Waveform Monitor	4
1485 PAL/NTSC Dual Standard Waveform Monitor	4

Tektronix®

COMMITTED TO EXCELLENCE

1/80

A-4218